STATE OF CALIFORNIA

AGENCY

Resource Assessment Methodology Case Studies

California Continuing Resources Investment Strategy Project
(CCRISP)

The Resources Agency
June 1, 2001

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Mary D. Nichols Secretary
The Resources Agency
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Executive Summary

A primary objective of the California Continuing Resource Investment Strategy Project (CCRISP) is to facilitate the development and implementation of strategic programs and processes that will ensure the long-term perpetuation of the State's unique biological diversity and natural resource values. An important component of this effort is identifying a methodology, or set of methodologies, which generate a better understanding regarding the current health and condition of the State's resource base. Such understanding can help guide priorities for conservation actions, including: better management of current publicly owned lands, future acquisitions and working with private landowner partners to improve and enhance resource values.

This analysis reviewed the approaches of other programs which assess the health and condition of natural resources. Information gleaned from this review, along with insights gained from other investigative studies, is intended to assist in developing an optimum methodological approach for CCRISP.

For the purposes of this evaluation, the term "resource assessment methodology" refers to the various approaches taken by public agencies and private organizations, both within and outside of California, which characterize the current health and condition of natural resources or which monitor changes (improvement or decline) in the condition of resources over time. These various approaches build upon philosophies, methodologies and commitments to resource assessment which vary widely. The challenge for CCRISP is to draw upon the strengths and lessons learned from these and other developing programs, to identify the methodologies that work best toward achieving its goals and objectives.

Approach

The Resource Assessment Methodology Case Studies is one of several research-oriented investigations prepared to aid in the formulation of methodologies for CCRISP. This report involved identification and review of candidate programs within three primary focus areas:

- State agency programs
- Other State and federal programs
- Private sector programs

Key contacts for each of the selected programs were identified. An interview questionnaire was prepared, covering a broad range of assessment characteristics and methodology components. This questionnaire was then sent to the appropriate key contacts. These respondents were either interviewed or, in some instances, mailed the questionnaire. In most cases published documents describing the subject programs were also reviewed.

Our sampling included a wide spectrum of assessment-based programs. The primary focus was on programs that utilized, as a central part of their assessment methodologies, components for determining the health and condition of the resource or natural system. As a secondary goal, we looked for programs with complementary elements to CCRISP in terms of common goals, scopes and needs.

KEY FINDINGS

Unlike our experience with conservation priorities methodologies, there is not a set of experiences in other states, and a body of scientific literature targeting state level assessments of the health and condition of natural resources.

While, as noted by EPIC staff, most states are ahead of California in developing "State of the State's Environment Reports" with a broad set of environmental indicators, those reports tend to be focused on the state of the environment for the human community, not natural resources and ecosystems. In addition, most state of the state reports do not emphasize geographic analysis: locating particular problems for the natural environment by ecoregion, or within a watershed. There are particular programs to measure and identify the spatial distribution of specific problems, such as change in land cover over time (Forest Resources Assessment Program) or the relative impairment of beneficial uses of water bodies due to water pollution (the State Water Board 303(d) program).

However, while there are few long standing programs to rely on, there are several programs in California in different stages of development that do try, either for parts of the state or for landscape level geographic areas, to assess the health and condition of resources. California does have a Statewide Indicators Program in development at Cal/EPA, which is intended to be the basis for a State of the State Report. The Cal/EPA Environmental Protection Indicators for California (EPIC) Program and the California State Parks Inventory Monitoring and Assessment Program (IMAP), have not yet been implemented. In contrast, the California Department of Forestry (CDF) Forest Resource Assessment Program (FRAP) and some Department of Fish and Game (DFG) programs have been underway for many years now. The proposed DFG Resource Assessment Program will begin on a small scale in the next fiscal year.

We found wide variance in terms of emphasis placed on the assessment of natural resource health and conditions. Cal/EPA EPIC utilizes key indicators for a broad range of environmental factors, including natural ecosystem values. As will be further discussed in the separate report on the proposed CCRISP methodology , there is the opportunity for cooperative efforts with CaL/EPA on the EPIC program to insure that spatial designations and appropriate indicators are developed to be compatible with CCRISP. There is also the opportunity to use the State Parks IMAP program for a landscape or major watershed level program to evaluate all current state conservation lands. Cooperation between the Department of Fish

and Game and the CCRISP program is also anticipated as we both launch resource assessment programs. The Resources Agency North Coast Watershed Assessment Program (NCWAP) is beginning resource assessments for five watersheds. These assessments should be monitored as pilot projects for CCRISP.

In the Forest and Rangeland Resources Assessment (FRAP) program, it was the respondent's opinion that tremendous opportunity exists for beneficial linkage between CCRISP and FRAP. FRAP collects and screens data from a variety of sources and performs a coarse scale analysis of many of the issues relevant to CCRISP, including resource health and condition. These functions of FRAP could help identify key natural capital attributes, analyze critical questions and support CCRISP decisions. Similarly, the Wilderness Coalition programs are similar in purpose to CCRISP and utilize complementary methodologies.

Identified methodologies for the Water Resources Control Board Surface Water and Ambient Monitoring Program (SWAMP) suggest considerable overlap with the CCRISP program agenda and conceptual scope. SWAMP methodologies, designed to handle extensive quantities of data and a variety of assessments, seem particularly relevant to CCRISP. Also, the SWAMP program seeks to provide a clear picture of the status and trends of water quality throughout the State, objectives that parallel those of CCRISP.

The US Forest Service Large Scale Watershed Program is interested in addressing both natural resource needs and human (community) needs for use of the lands, a concept that is key to CCRISP. The Program will monitor the health and condition of watershed resources, and of those who rely on watershed resources. As such, the Program provides a model with potentially significant applications for CCRISP.

A similarity between the Florida Closing the Gaps Program and CCRISP is the use of: species models, identification of land changes over time, and the use of spatial analysis to identify specific areas to be targeted for conservation action (primarily acquisition).

Other programs reviewed here have less promise for being closely linked to CCRISP's resource assessment project. While the California Natural Diversity Data Base (CNDDB) is an important tool for many reasons, it is designed for the positive sighting of endangered or rare species within habitat areas, not for a comprehensive assessment of the health and condition of resource habitat. In the CNDDB program, determination of resource health and condition is more incidental to other primary functions of the program. For this reason the Department of Fish and Game, like the other two major land management agencies in California, is beginning a new assessment program.

While the purpose of this report was to report and assess what others are doing relative to assessing the condition and health of their natural systems, we found that virtually all of the above efforts focus more on moving from the existing condition, whatever that is, forward toward an improved future condition. Existing or developing landscape-based conservation initiatives are not generally focused on a qualitative assessment of current condition. Many of them are more focused on monitoring the progress made toward a desired future condition.

Although still in their formative stages of development, this study concludes that the DPR IMAP, Cal/EPA EPIC, and the SWRCB SWAMP programs perhaps offer the best points of departure for formulating a resource assessment methodology for CCRISP because of the parallel alignments of purpose, objectives and scope. The extensive FRAP data base and analytical framework will also be useful for assessment purposes for much of the State. The North Coast Watershed Assessment Project, just about to launch its resource assessments, also will provide pilot studies for CCRISP.

I. Introduction

This study is one of several research-oriented investigations currently underway to provide substantative background information as an aid in the formulation of methodologies for the California Continuing Resource Investment Strategy Project (CCRISP). CCRISP serves as a strategic approach to resource investment in a wide range of priority natural lands and resources in California. The goal of the CCRISP project is to support decision-making capabilities related to a broad spectrum of resource related objectives. These objectives include:

- Protecting and stewarding high priority natural resource lands.
- Protecting prime agricultural lands, rangelands and forest lands in terms of resource production potential and for their natural resource values.
- Protecting and stewarding natural lands that support outdoor recreational and educational facilities and pursuits.
- Protecting critical watershed ecosystem values.
- Identifying and protecting significant urban natural areas.

This broad range of multiple conservation objectives will ensure the development of conservation strategies that can address the diversity of important lands and natural resources in California. With such a broad overview, the tradeoffs between different values associated with the resources can be measured by decision-makers when making determinations about the optimum strategies involving the use and protection of our key resources.

This report provides an overview of current resource assessment methodologies employed by programs within: California state agencies, federal agencies, other states with evolved resource assessment programs and private sector initiatives. specific type of resource assessment programs reviewed include at least some component for determining the health and condition of high priority conservation resources. These case studies were analyzed for their strengths and weaknesses, and their applicability to the basic resource assessment questions that CCRISP will ask.

These case studies summarize the key characteristics, function, strengths, weaknesses and specific purposes of various programs that are either already implemented or are being readied for implementation. Information gleaned from this review, along with insights gained from other investigative studies, will contribute to developing an optimum methodological approach for CCRISP. A preliminary draft methodology for CCRISP was submitted to the Legislature on April 2, 2001 and a final methodology currently due to the Legislature on July 1, 2002. Included in this report will be a final resource assessment methodology.

The goal of the resource assessment methodology is to establish a statewide program for assessing the condition and health of high priority conservation lands for the broad range of resource categories described above.

This report considers how specific programs look at available information and which decision-making processes are employed in making a determination regarding the condition of the resource. Assessments were not made of the information or data used by the various programs reviewed. (A data analysis is addressed by the separate report *Evaluation of Existing Data Sets and Identification of Important Data Gaps*). Nor is there any comparative assessment of the relative importance or validity of a particular program. The objective of this investigation was to provide a quick overview of the range of methodologies involved with resource and habitat assessment and monitoring which could be of use in guiding the design of the CCRISP resource assessment methodology.

II. California State Programs

Cal/EPA Program Overview – Environmental Protection Indicators For California (EPIC), Office of Environmental Health Hazard Assessment

Background and Basic Questions Addressed

The California Environmental Protection Agency (Cal/EPA) assigned the Office of Environmental Health Hazard Assessment (OEHHA) the task of formulating a program built upon environmental indicators as an integral part of a wider strategic planning process. The Environmental Protection Indicators for California (EPIC) is a preliminary product developed for this purpose. The objective of EPIC is to provide meaningful information for the array of Cal/EPA's environmental programs. However, the EPIC program is considered a transitional program. Cal/EPA intends to move from an environmental indicators approach to an environmental index or a set of indices that "can simply and effectively communicate the overall status of California's environmental quality." The categories for the Cal/EPA environmental indicators mirror the structure of the agency's constituent programs: air, pesticides, hazardous and solid waste and water. This program is too early in its formative stage to make a definitive assessment at this time. Because of this, and because it is already evident that EPIC and CCRISP will have significant overlap, there is a significant opportunity for the Resources Agency and Cal/EPA to develop a cooperative work program to enhance both efforts.

The EPIC Program does not include the detailed components of an assessment program since it was not intended to develop a landscape level data system for resource assessment or monitoring. At this point, it appears that EPIC is looking for the same kind of information that CCRISP would look for statewide and in specific kinds of ecosystems, but in contrast, is not broken down spatially into eco-regions, watersheds or other geographic units for analysis. That may

change as the program evolves. It is possible that this kind of analysis is what CCRISP could contribute to EPIC.

Program Goals and Objectives

The principal objective of the EPIC program is to build a defendable scientific foundation for guiding planning decisions. As stated above the range of indicator categories of the EPIC indicator program is broad in terms of the types of conditions and factors that are being addressed and it is intended to parallel Cal/EPA's regulatory scope authority.

Status of the Cal/EPA Program

The EPIC program is in a conceptual stage of development. The following description summarizes the framework prepared to date, built upon the use of environmental indicators. OEHHA has not reached the point of developing data nor have they specifically identified the type of data needed to measure the indicators.

EPIC Program Methodologies

The EPIC program is structured around the use of environmental indicators. The basic function of the environmental indicator is to provide “a measure that presents scientifically based information on environmental conditions.” The issues addressed in the EPIC program include:

- Air quality with the sub-issues of air pollutants, air contaminants, visibility and indoor air quality. Applicability to CCRISP includes relationship between air contaminant/pollution and the viability and condition of resources.

- Water with the sub-issues of water quality and water supply. Applicability to CCRISP includes relationship between water quality and water supply and the health of aquatic and dependent terrestrial ecosystems.

- Land, waste and materials management with the sub-issues of material use, energy consumption/production, waste generation, land disposal, cross-media contamination and the loss of natural resources. There are primary and secondary relationships affecting the condition and health of ecosystems in terms of toxics or other pollutants that affect adjacent ecosystems and the land consumptive and poorly fitted use often sited within natural settings.

- Human health as related to environmental exposure with the sub-issues of bioaccumulation of toxic chemicals and environmentally related health conditions. Issues related to bioaccumulation of toxic chemicals apply similarly to natural habitat, agricultural lands, timber and rangelands,

watershed dynamics, urban ecosystem value and ability to restore urban ecosystems.

- Ecosystem health (see the issues and sub-issues discussion below)

- Pesticides with the sub-issues of air, water, residue in foods, pesticide use and integrated pest management. Issues related to pesticide use, fertilizers and other chemically based practices used for resource production and management or landscaping have a direct relationship to the health/condition of natural lands and managed resource areas.

- Trans-boundary issues with the sub-issues of global pollution and trans-border pollution. Trans-boundary issues are particularly relevant to health and condition assessment with the specific issues of: introduced exotic species and the displacement/ extirpation of indigenous species: release of potent pathogens: global economy and effects on land use and management: trans-boundary water pollution: water supply issues and air pollution from vehicles and industry on the border. The documentation of this important category of impacts will help to define a more complete picture of the critical issues affecting the condition of conservation lands and natural resources.

Ecosystem Health

The issue topic most directly relevant to the CCRISP program is ecosystem health. The EPIC program defines ecosystem health as the ability of an ecosystem to rebound from stress. An underlying supposition is that the integrity of our ecosystems is challenged on a regular basis by various "stressors" including chemical, physical and biological factors. An additional facet of this view is that "only in those ecosystems that have experienced a loss of 'key structural components' will there be the consequence of permanent damage to the ecosystem." And finally, the structural and functional integrity of the ecosystem is the key factor in the maintenance of viable ecosystems.

The EPIC program outlines a series of broadly applicable issues that address the health of California's ecosystems.

Key Indicators

The use of indicators as a basis for determining the health and condition of ecosystems is based on a fundamental understanding of the extent and overall use of each ecosystem. The following definitions of indicators are in draft form and are subject to further refinement.

- Land cover: Land cover is a general measurement of the spatial extent of a particular ecosystem. Knowledge of land cover permits an analysis of the change in the extent of the various ecosystems over time, and thus

can be a coarse indicator of health and viability. Land cover measurements help define the broadest categories of natural verses altered ecosystems.

- Wildlife habitat quantity: Addresses the cumulative effects of increasing human pressures on wildlife habitats. A systematic land and aquatic based vegetation classification system, referred to as the California Wildlife Habitat Relationship (CWHR), is key for determining the relationships between wildlife and their particular habitats. By measuring the extent of these CWHR habitats, inferences can be made about the potential adverse impacts of development and management activities on wildlife species.

- Land use: Changes in land use present the most profound extent of ecological impacts attributable to human activity. These changes include conversion of natural systems and communities into agricultural systems, altering hydrological or chemical cycles and transforming the earth's surface to the built environment. Classifying current land use is a fundamental step in monitoring change and defining the components of ecosystems most at risk.

Status and Extent of California Ecosystems

Pertains to status and extent of individual California ecosystems, which is seen as a prerequisite to assessing issues related to biological integrity in California. Cal/EPA has outlined seven ecosystems for the purposes of the EPIC project:

- freshwater
- coastal/marine
- forest
- grassland/rangeland
- desert
- agricultural
- urban

The following describes the specific issue categories based on the seven ecosystem topic areas outlined above.

Health of forest, shrub and grassland (terrestrial) ecosystems

- Loss of biodiversity.

- Habitat quality alteration: Air pollution, fire, flood, harvesting and development result in changes to forest age, size, density, soil organic matter and loss of structural components such as snags and down logs.

- Habitat loss.

Health of the coastal/marine ecosystems

- Habitat protection: The preservation of physical habitat as well as suitable water chemistry and quality.
- Aquatic life protection: Loss of habitat and competition with introduced species, as well as degradation in water quality and depletion of natural resources beyond the system's capacity to recover.

Health of freshwater/aquatic ecosystems

- Habitat protection: Surface water body hydrology and stream channel morphology. Water quality, maintenance of particular flow regimes, substrate types, temperature regimes, types of canopy cover and other physical habitat parameters.

- Aquatic life protection: Stressors associated with water quality and habitat degradation, as well as competition from non-native species.

Health of desert ecosystems

- Habitat degradation.

- Alteration in biological communities.

Health of agricultural ecosystems

- Loss of agricultural land.
- Water quality and quantity.
- Degradation of agricultural land: Increased salt build-up and accumulation of toxic salts.
- Positive and negative environmental impacts: Pesticides.

Health of Urban Ecosystems

- Air quality.

- Drinking water quality:

- Discarded material: Solid wastes.

- Exposure to hazardous materials.

- Loss of urban land for in-fill development.

- Sustainability: The healthy functioning of an ecosystem and its ability to withstand injury.

Social aspects of ecosystems

- Recreation.
- Employment.
- Expansion of ecosystem service and restoration industries.
- Technology impacts.
- Quality of living space and lifestyle.
- Civic engagement.
- Regional planning and resource management.
- Population growth and settlement patterns.
- Trans-border issues.

Subjective Evaluation of the EPIC Program

EPIC supports the various programs within the auspices of Cal/EPA, and thus covers a much broader range of interpretations of "environmental indicator" than may be relevant to CCRISP.

Broader Applications and Adaptability of the EPIC Program for a CCRISP Resource Assessment Methodology

Although the Cal/EPA EPIC program is still in its early stages of development, the parallels to the purpose and approach being considered by the CCRISP program are remarkable. The development of EPIC and CCRISP should be carefully reviewed for applicability to eachother. EPIC's multi-issue approach closely resembles the CCRISP broad resource spectrum approach. The platform of environmental indicators provides insights regarding the manner in which the resource conditions can be tracked over time. At this point, it appears that EPIC is looking for the same kind of information that CCRISP would look at statewide and in specific kinds of ecosystems, but it is not broken down spatially into eco-regions, watersheds or other geographic units of analysis. That may change as the program evolves. Certainly this kind of analysis is what CCRISP could contribute to EPIC.

Program Overview of FRAP, the Forest and Rangeland Resources Assessment Program (CDF)

FRAP was developed by the California Department of Forestry and Fire Protection (CDF) to assess the conditions and trends of California's forest and

range resources.[1] The FRAP study area encompasses approximately 80% of California's land area, and includes all landscapes except urban areas and irrigated agricultural land. The FRAP program is very broad in that it assesses natural, economic and social capital. The program considers biodiversity, recreation and amenity conditions of forest and rangelands, and recognizes different ownerships, needs and management directions. It fully integrates the effects of "human interaction on natural capital components" to the extent that applicable data is available. Even though it does not assess urban areas or irrigated agricultural land, it does consider the effects of urban land and agricultural land on forest and rangeland resources.

In this case, the survey respondent was familiar with CCRISP and had comments regarding the relevance of FRAP to CCRISP. It was the respondent's opinion that there is tremendous opportunity for coordinating the efforts of CCRISP and FRAP. The respondent elaborated that since FRAP collects and screens data from a variety of sources and performs a coarse scale analysis of many of the issues that are relevant to CCRISP, FRAP can help identify key natural capital attributes, analyze critical questions and help support CCRISP decisions. Indeed, FRAP may prove to be very compatible to the CCRISP effort.[2]

Basic Questions the FRAP Program is Trying to Answer

What are the demands, supply, constraints and opportunities that affect California's forest and rangeland resources?

Goals the FRAP of Program

The primary goal of the FRAP program is to "provide an assessment of the status and trends of forest and rangeland resources of California so that the State can develop and implement forest [and rangeland] resource policies."

Status of the FRAP Program

The FRAP program has been fully operational and ongoing since 1978. The program was designed in-house, but is being refined through a stakeholder process. This stakeholder process resulted from the need to collaborate with FRAP's "partners in data", which are usually government agencies that are

[1] A summary of the legislative mandate for FRAP can be found on the following website:http://www.leginfor.ca.gov/cgi-n/displaycode?section=prc&group=04001-05000&file=4789-4789.7

[2] The following information, highlighted by the text in quotations, is based on a survey response and discussions with Chris Zimny, Resource Assessment Forester, Fire and Resources Assessment Program (FRAP), California Department of Forestry

encouraged to be involved in "the use and presentation of their data sets." The stakeholder process is mandated in Public Resources Code section 4789.3b.

Eventually, according to the survey respondent, the stakeholder process may enter the arena of review by other government agencies and the public (after approval by CDF).

There are provisions for upgrading the FRAP program. "A key focus of this assessment is to periodically update data sets for reassessment and interpretation. In addition to upgrading the program, there are also adaptive management features." These updates are a function of how issues change and lead to different questions being posed to data sets.

Methodology Components of The FRAP Program

According to the survey respondent, "the CDF FRAP Assessment Team identified the mandated assessment topics and other relevant issues needed for analysis in the Assessment. Specific indicators and data sets portraying the status and trends of forest [and rangeland] resources and issues were identified. These indicators and data sets were categorized to reflect natural, economic and social conditions in California's forest and rangelands. Information was then collected and analyzed to assess these conditions.

Information collection and analysis includes the following:

- Literature searches for statistical, GIS, and commentary data sets,
- Extensive analysis of numerous external data sets relevant to forest and range issues.
- Original spatial data collection from satellite, photographic, cartographic and historical sources and additional GIS analysis of spatial data set to portray conditions and identify interactions.
- Publication of results and integration of critical feedback."

The key indicators used for assessing resource or habitat conditions, include:

Natural Resources Indicators:

- Changes in the extent and quality (e.g. degree of fragmentation, similarity to optimal distributions) of key resource attributes
- Spatial GIS maps and acreage table summaries of extent and quantity of life forms and wildlife habitats
- Quantity and condition of key habitats of concern (old growth/hardwood/riparian)

- Structural condition descriptions of wildlife habitats
- Habitat loss/land use trends
- Species diversity and threats to biological diversity
- Ability of forest and rangeland to produce ecological services including air purification water quality; soil regeneration; climate regulation
- Ecosystem disturbance including fire and pest conditions

Economic Indicators:

- Demand, supply constraint and opportunity analysis for forest resources identified in PRC law.
- Employment level and economic structures.
- Export/technology innovation impacts. This refers the role of export technology innovations, which collaterally affect both the global economy and the resource, such as innovations which increase the production of lumber or meat.
- Ecosystem restoration industries.
- Urban based resource industries (for example, the use of landscaping byproducts to product new products).

Indicators of Social Conditions:

- Population growth trends.
- Demographic profiles and impacts.
- Rural community structure including level of government services, level of life style amenities, opportunities to experience nature, capacity to make decisions, settlement patterns and institutional arrangements including management patterns, ownership patterns and regulatory trends.

Data Management

The data categories required for determining habitat and resource condition include: "GIS remote sensing data, field plot inventory from national Forest Inventory Analysis Program,[3] State and Federal agency data bases, expert

[3] In the Forest Inventory Analysis program, sponsored by the US Forest Service, sample plots are routinely sampled for statistical information. F.I.A. datasets are used By FRAP to quantify forest acreage and tree volume.

opinion and public opinion polls." FRAP does not conduct opinion polling itself, nor does it contract them out. FRAP relies on existing sources of information and communicates directly with information providers to obtain necessary information about existing datasets, surveys, public polls, etc.

Due to the variable nature of the data, data screening is an essential part of the process. "All data sets are individually checked by analysts for accuracy, consistency, and relevance."

With the exception of the Land Mapping and Monitoring Program,[4] FRAP does not perform any field verification. As previously mentioned, FRAP relies on existing information from the outside, which it collects, screens, compiles and analyzes.

Peer review provides an important component of the methodology and usually takes place informally, as a review by the state for the federal agency that provided the original data. Before any information is put on the FRAP website, it goes through a "formal business review." Some of the information is used as a basis for future projections, such as for population growth in forest and rangelands, undergoes a formal publication and peer review process.

The FRAP methodology is intended to be applicable to multiple types of regional landscapes, but focuses primarily on forest and rangeland types. The scale and units vary by type and source of data. According to the survey respondent, "Data sets used for habitat extent and condition should be statistically relevant to scales down to 1 hectare and be aggregated by bioregion, watershed and county level summaries. Physical data on forests and range conditions are often collected, verified and analyzed at scale units less than 5 acres (or approximately 2 hectares). FRAP invests in primary collection of this type of data. For certain applications, physical data is analyzed at 5,000 acre to 10,000-acre units as well as increasingly larger units. "

"Economic and social data," according to the respondent, "is applied at the scale and resolution at which it was initially collected," which usually exists as county-scale data, but may be at another scale, such as a statewide scale. "With the exception of census data, [economic and social data] is rarely accurate at [a scale] more detailed than by county. To the extent feasible, all data sets are further summarized at statewide, bioregional and county level levels."[5]

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[4] Land Mapping and Monitoring Program is a cooperative effort between FRAP and the Forest Service to detect changes in the land using satellite imagery

[5] The term bioregion, as in any of the units used by FRAP, depends on the source. Bioregional usually refers to the California Biodiversity Council Bioregions. It could, however, refer to a county-based bioregion for per capita income or it could be the San Joaquin County air basin.

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The temporal scale that FRAP focuses on is primarily the previous decade. According to the survey respondent, the "presentation of data sets used in trends analysis focus on a 10 year period from 1990 to 1999. Additionally, as data sets are available and trend information is relevant, information extending back to 1940 (land use trends) may be presented. Some data sets also projected into the future for population and land use trends to 2040."

The Respondent's Subjective Evaluation of the FRAP Program

"This method of resource assessment depends on outside sources of data sets and on CDF FRAP compilation and interpretation of data. Many sources of information must be sought. Sources of data often may not be specifically relevant to a particular resource or issue of concern. Natural systems and their interactions with people are both complex and uncertain. Linkages are often presented as hypotheses with supporting data and analysis. Publication and critical feedback are key components of improving the quality of the analysis. One weakness is insufficient detailed data available to create a good picture or make definitive statements of habitat conditions. Also, significant GIS analyst skills are needed to integrate and analyze information and results."

Broader Applications of the FRAP Program

The intended end users of the FRAP program are the Agency Resources Secretary, the Board of Forestry, the State Legislature and the general public, or any user who is interested in California's forest and rangelands. Information is available for broader stakeholder use via the FRAP website. In some cases, proprietary issues limit the detail of the information that can be disseminated by FRAP, but these situations are rare. Proprietary information, such as private landowner timber harvests, is summarized to conceal owner or business specific results. The survey respondent stated that FRAP methodology is applicable to other State assessment programs since the "identification and inclusion of key data sets that represent natural, economic and social conditions which are reproducible over time is a methodology that lends to consistent and interpretable findings." One problem, however, is that there is a lack of common data collection definitions. Since FRAP relies on other sources for most of it's data, it does not have control over the establishment of common data definitions. For example, a report on the loss of rangeland might be difficult for FRAP to interpret because the land base in the study was expanded since the previous survey, or perhaps there was a reclassification of the data by the source.

The respondent further stated, "the forest rangeland assessment goals have adopted a very broad set of desired outputs ranging from natural descriptors of ecological process to social economic implication of resource trends to institutional policy recommendations to improve resource conditions. Lack of a common definition and data collection might lessen with closer cooperation

[between other government agencies]." CCRISP may be able to play a key role in conducting this kind of data synthesis between agencies.

Program Overview of IMAP, the Inventory, Monitoring, and Assessment Program

The Inventory, Monitoring and Assessment Program (IMAP) was developed in-house by California State Parks to provide biological information for use in park management. Design and implementation of IMAP involves a planning process, called Environmental Condition Assessment (ECA), for establishing long-term monitoring that uses environmental indicators as a primary tool to assess current resource conditions and to detect change in these conditions over time.

The IMAP process is in part modeled after the National Park Service's (NPS) "vital signs" process (Gary Davis, NPS *in press*) with environmental indicators as the primary parameters that, when measured over time, provide information about overall trends in ecosystem condition. It is envisioned that by monitoring integrated sets of indicators this process will provide valuable information, in an efficient manner, on the response of environmental complexes to primary identified stressors including visitor use, park management, internal and external forces.

The primary strengths of the IMAP methodology include the program's emphasis on advanced planning that allows for adaptive management for fine-tuning the approach for a specific project area. Additionally, State Parks is counting on an additional pool of support through volunteers that are available through the many park associations throughout the state to participate in the collection of baseline information and monitoring.

As the program is very new, staff members are still getting set-up and they anticipate having to "debug" the process during the formative period. Ultimately, they hope to establish a "cook book" approach that will be primarily applicable at the small unit scale.

Basic Questions the IMAP Program is trying to Answer

Is the (eco-system) area/unit healthy? If not, why? What are the evident trends affecting the specific resource (usually defined by the boundaries of the park unit) as viewed over time?

Goals of the IMAP Program

- To produce an accurate inventory of resources including vegetation, wildlife and aquatic features.
- To track the condition of these specific resources over time. The initial inventory is the first visit (baseline assessment), which then becomes the

means for measuring long-term trends that can be used as feedback for management related actions.

- To help managers understand how natural systems are responding to internal and external influences and threats.

- Evaluate the ability of ecological systems to sustain biological diversity while providing visitor recreation and education opportunities.

- Anticipate or forecast emerging natural resource problems before they reach crisis levels.

- Monitor progress in maintaining and restoring ecosystems and ecosystem processes, both in natural areas as well as heavily used and modified sites such as day use areas and camp sites.

- To inform management practice, improve allocation of resources to the problems that are most threatening to ecological systems, and inform acquisition planning and other activities to defend park ecosystems from external and internal threats.

Status of the IMAP Program

IMAP is in the initial program stages and the methodology developed to date is described below. Some parts of the program have been implemented. Pilot studies have been implemented at Chino Hills in San Bernardino County and Wilder Ranch in Santa Cruz to field test and dry run these features. Ultimately, peer review needs to take place. The program will try to set up protocols at the design stage to incorporate input from the appropriate team of experts to undertake a review of the project and project methodology. As the program is still new there has been little information published to date to support peer review input or to test and refine the conceptualization process.

Methodology and Components of the IMAP Program

Key program components of the IMAP program include establishing a mapping framework for a specific area and applying the Environmental Condition Assessment Program (ECA), a 15 step planning process to determine what should be monitored and why. This process also will serve to determine what specialists may be needed to set-up the study design and fine-tune the study methodology. The Environmental Condition Assessment Program (ECA) is intended to:

- Identify the status or condition of sensitive species.
- Identify the status of selected indicator species.
- Identify the status or condition of key processes (fire, nutrient flow, hydrologic cycles) in environmental complexes.
- Identify threats.

- Document and display data in a manner which allows managers to assess local conditions and events (such as a wildfire) within the context of surrounding regional conditions and events.
- Represent current knowledge, yet accommodate modification as new knowledge and techniques are developed.

Based on the methodology outlined above, the key indicators used for assessing habitat or condition may vary from study area to study area. Indicators can be processes as well as individual species or other physical elements. Assessment may interject more general information as a means to determine the health status of the resource.

Data categories for determining habitat/resource condition include standard baseline data categories, i.e. vegetation, wildlife, hydrology, geology, land use and other human use data. Data sets will be customized to the particular study area or park unit.

Spatial scale is determined by the size of the park unit. Typically, studies will focus on watershed level data that encompasses the study unit. It may not focus on a single biological type or area but rather include multiple biological types.

The temporal scale of the program is intended to extend from initiation period to an indefinite future time for on-going monitoring capability. Generally, it is expected that a window from 5 to 15 years is required to effectively isolate cyclical patterns from significant trends. There is a large amount of anecdotal historical information that may eventually be incorporated into the monitoring program, but a strategy for doing so has yet to be developed. Much of this historic information is in hand written notes or miscellaneous files kept at the park units.

A significant desired component of the methodology and implementation program is adaptability. The program includes an emergency response type of monitoring feature. Emergency response capability would be event oriented to respond to catastrophic occurrences such as fires, floods, spills or other events. The program is also structured to enable a learning curve between the initial planning phase and implementation of the on-going monitoring program. This enables targeting the most salient factors as well as fine-tuning measuring methods and standards.

The field verification protocol for the program is just getting underway and will involve senior level statistical review. No formalized procedure has been established at this time for conducting data review. Staff may utilize outside contractors to confirm initial findings. The availability of this information will be on a case-by-case basis, but some data review information is available at this time.

The methodology incorporates an assessment of the effects of human interaction and impact on biological diversity by utilizing the following primary categories of actions or influences that could be affecting the resource:

- The visitor
- The resource's neighbors
- Nature (Acts of God)
- Ourselves (existing park management and operations)
- Other non-point factors such as air & water pollution, climate change (global warming) and invasive species.

Data screening for the program will be employed at the unit level for each of the 264 units. Data screening methodology is described below. The park ecologist responsible for data consolidation, serves as the quality control manager for the program and establishes quality control for each unit.

Data screening for field collected data is based on a specimen voucher protocol that is used to standardize field checking derived information. Data managing structures are still being developed for handling disparate data sets such as aerial photos, raster data and GIS information.

There are many resource management and restoration efforts going on at state park units. There is also an emphasis on: acquisitions to connect protected units; and "defensive planning activities" undertaken in each district to work with local governments, other state and federal agencies and private landowners to assure that State Parks are adequately protected from activities that could impact them. Ultimately, it is anticipated that the contributions of these various activities will be incorporated into a coordinated plan but they are not incorporated at this time.

Subjective Evaluation of the IMAP Program

It's still too early to say what the limiting factors of the program design will be. Currently, lack of money, time, people, and the limited availability of data to signal evaluation needs, seem to be the primary limiting factors. Additionally, two other major factors complicate the ability to effectively apply this assessment approach:

- Lack of adequate knowledge of the basic ecological elements occurring in the park units (there is no GIS System, except what is currently available in Technical Services Center, and no organized data layers for park units).
- Difficulty in deciding what the desired environmental condition actually should be. For example, pre-contact conditions (pre- 1500's) may be a desired optimum goal but it may be difficult to define in many of California' more disturbed landscapes.

An improvement suggested by a Department representative involves adding capacity to handle multiple scales of analysis to enable a more adaptive approach.

Presently, there is no defined product requirement and there is probably a need to establish some type of published statement to be produced at regular

intervals. Information provided in this report would not need to be exhaustive but rather could highlight major issues and interesting findings. It would be ideal if this summary review could include all park units that involve some type of natural resource management.

Broader Applications of the IMAP Program

The end users of the IMAP, who are primarily the park managers at the district level and the unit rangers, are optimistic about this program. IMAP may have a potential for sharing data with other management agencies such as DFG, whose monitoring needs for land management parallel the needs identified in the IMAP process.

As stated above, IMAP derives in part from the NPS ECA program. Conceptual development to date has involved significant coordination with DFG programs and the FRAP program. Because of IMAP's parallel purpose, objectives and scope with CCRISP, it offers a good point of departure for formulating CCRISP's resource assessments in parklands.

Program Overview of the North Coast Watershed Assessment Program (NCWAP), Resources Agency

The North Coast Watershed Assessment Program (NCWAP**)** is a multi-agency effort led by the California Resources Agency to assess biophysical conditions in north coast watersheds. The five state agencies participating in the program include the California Department of Forestry and Fire Protection (CDF), the Department of Fish and Game (DFG), the Department of Conservation's Division of Mines and Geology (DMG), the Department of Water Resources (DWR), and the State Water Resources Control Board North Coast Region (RWQCB). A flow chart for the NCWAP process has been included in Attachment 3.

Products to be developed by the NCWAP for each watershed include:

- An environmental database, including original maps of landslides, landslide potential, land use maps and maps showing vegetation changes over time, fluvial geomorphology and an accessible compilation of existing information.
- An assessment of factors limiting anadromous salmonid production.
    - A synthesis report describing the results and implications of the watershed assessment.

The goals, processes, scales of analysis and issues being addressed by the NCWAP are similar to those of the CCRISP program. The assessment of land use changes over time within the targeted watersheds of the NWCAP should

provide valuable information regarding the current condition and health of those watersheds for use by CCRISP.[6]

Basic Questions Addressed

There are seven primary questions that the NCWAP is attempting to address:

- What are the general relationships between land use history (development, timber harvest, agriculture, roads, dams and diversions) and the current vegetation and level of disturbance in North Coast watersheds, and how can these types of disturbances be quantified?

- What is the spatial and temporal distribution of sediment delivery to streams from landslides, bank, sheet, slope and other erosion mechanisms, and what are the relative quantities for each source?

- What are the effects of stream, spring and groundwater uses on water quality and quantity?

- What role does large woody debris have within the watershed in forming fish habitat and determining channel class and storing sediment?

- What are the current salmonid habitat conditions in the watershed and estuary (flow, water temperature/shade, sediment, nutrients, in-stream habitat, etc.), and how do these compare to desired conditions (life history requirements of salmon, basin plan water quality objectives, etc)?

- What are the sizes, distributions and relative health of populations of salmonids within watersheds?

- Do the current populations and diversity of aquatic communities (especially salmonid fishes, macro invertebrates and algae) reflect existing watershed and water quality conditions?

Goals of the NCWAP

The NCWAP provides a relatively course scale (general) assessment aimed at characterizing current watershed conditions. Such assessments are intended to provide a set of baseline data for further use in more detailed watershed analyses and to support more specific site-related planning, management,

[6] The following was taken from a survey response from Cathy Bleier, Special Assistant on Watersheds and Salmon, California Resources Agency, and from other literature listed in the bibliography (See Appendix C).

monitoring and policy decisions aimed at protecting and enhancing identified watershed values. Identified goals of the program are to:

- Provide a baseline for evaluating the effectiveness of various resource protection programs over time.
- Guide watershed restoration programs (e.g., targeting grant dollars to those projects which most efficiently and effectively recover salmonid populations, and assisting local watershed groups, counties, etc., to develop successful projects).
- Guide cooperative interagency, nonprofit and private sector approaches to "protect the best" through stewardship, easement and other incentive programs.
- Help landowners and agencies implement laws that require specific assessments such as the State Forest Practice Act, Clean Water Act and State Lake and Streambed Alteration Act.

Status of the NCWAP Program

The watershed assessment for the North Coast is anticipated to conclude in six to seven years.

Methodology Components

The primary components of the NCWAP methodology are:

- Stream channel classification system (using gradient and channel confinement)
- Riparian vegetation assessment
- Sediment production and transport analysis
- Water quality assessment
- Fish habitat assessment
- Land use historical analysis, social and economic assessment
- Limiting factors analysis of fish habitat conditions, using a program called the Ecological Management Decision-Support (EMDS) Program, originally developed by the U.S. Forest Service as a tool to help resource managers make informed decisions about landscape processes.

The NCWAP data categories, used to determine habitat/resource condition, include: land use, vegetation (cover, structure), upslope geology and channel morphology, sediment production and transport, water quality, water quantity, fish population data and fish habitat types.

The key indicators used to assess resource or habitat condition consist of the following:

- Disturbance and geologic stability: landslides, sediment storage, changes in land use/

- Riparian condition: water and air temperature, canopy, large woody debris, forest conditions, bank stability
- Water quality: water chemistry, macro invertebrates, sediment and turbidity, channel geometry
- Water quantity: stream flow and water rights
- Fish habitat: see riparian indicators plus sediment storage plus stream substrate

The data screening methodology used for the program varies, depending on whether the data is new or existing. Existing data may come from a variety of sources. Quality control and assurance standards must be applied to existing data in order to avoid drawing the wrong conclusions from data, assigning equal weight to un-equal data, or otherwise misusing the data. Before data from existing sources can be assimilated into the NCWAP, data are evaluated for quality and utility in the watershed assessment process using the following criteria: Is the level of detail appropriate? Is the level of supporting documentation adequate to define specific methodology used? Is the resolution used for the selected temporal and or spatial scale appropriate?

Although the evaluation of certain types of data can admittedly be somewhat subjective, existing data are then sorted into four categories: Excellent, Good, Fair and Poor.

It is the intent of the program to assure the quality of newly collected information through sound study design and the establishment of data collection protocols aimed at providing consistent precision and accuracy. At the present time, water quality data is the only type of data for which these protocols have been established.

A peer review process is currently being established for the program. The process, as currently conceived, would involve a team of 5-10 scientists responsible for providing technical program overview and recommendations for improvement. At the time of this report, peer reviewers had not yet been selected.

Currently, a system for assessing the accuracy of the various program GIS data layers has not been developed. As it proceeds, NCWAP will develop a series of metadata, and will validate data sets where possible, through field sampling, imagery interpretation and third party review.

The spatial scale used by NCWAP is a nested scale, derived from the CalWater Program, which includes small planning watersheds up to basins (aggregated watersheds within the same larger drainage system).

The NCWAP methodology involves a temporal scale, which looks at general land use change over a 150-year period, and examines photographic series for geologic function and land use over the past 70 years.

The NCWAP methodology incorporates the effects of human interaction and impact on biological resources, primarily through its assessment of changes in land use within the watersheds over time (e.g., timber harvest practices). In addition, the process involves working with local stakeholders, who craft study questions for each watershed basin and share mutually appropriate data.

Subjective Evaluation

The strengths of this methodology include its interdisciplinary and cooperative nature, commitment to peer and public review and willingness to adapt some of its field efforts to support local assessment and monitoring needs.

Program weaknesses include the potential difficulty of balancing flexibility and adaptability with standardized results. The extent of this challenge remains to be determined.

At this time, there are no provisions for updating the program.

Broader Applications of the NCWAP Program

The NCWAP methodology was designed for California's north coast landscape types. However, the basic underlying philosophy and approach, such as nested special scales, could be applied to other California landscapes. The effort currently utilizes individual assessment protocols from other programs and draws on watershed assessment models from other states as well. In addition, Ecological Management Decision Support could be used in support of many different landscape-based decision making processes across the state.

The intended end users of the NCWAP program are landowners, watershed groups and agencies. The assessment process and NCWAP products will be subject to public and scientific review. The products produced by the effort will be made available electronically through the Resources Agency website (CERES) and other means.

Program Overview of the Surface Water Ambient Monitoring Program (SWAMP): A Program for Water Quality Monitoring by the State Water Resources Control Board (SWRCB)

The methodologies identified below for the SWAMP program suggest considerable overlap with the CCRISP program agenda and conceptual scope. Because the SWAMP scope is so robust in terms of scale and levels of resolution, the methodologies for handling extensive amounts of data would seem particularly relevant to CCRISP. Also, the intended purpose of the SWAMP program is to provide a clear picture of the status and trends of water quality throughout the State: this creates a mission and set of objectives that parallel those of CCRISP.

The SWAMP program represents a restructuring of the existing State Water Resources Control Board (SWRCB) water-quality monitoring program. The proposed SWAMP program calls for:

- Regional monitoring to provide a clear picture of the status and trends of water quality.

- Site-specific monitoring to better characterize problem areas and clean locations.

- balancing the monitoring needs of the SWRCB and serve as a unifying framework for the monitoring services undertaken by the SWRCB and the regional water quality control boards (RWQCBs).

Coordinated SWRCB & RWQCB involvement in study design and sampling is a critical component in developing a comprehensive and effective program capable of identifying degraded systems and improving the conditions of state waterways. Other groups and agencies also use SWAMP, and the Southern California Wetlands Recovery Program is beginning to develop an assessment of water quality in Southern California wetlands and watersheds.

Basic Questions the SWAMP Program is trying to Answer

What is the current status of water quality, and what are the future trends in water quality?

Goals of the SWAMP Program

Level One:

- Integrate the existing water quality monitoring of the SWRCB and RWQCB.

- Coordinate with the monitoring programs of other agencies & organizations.

Level Two:

- Create an ambient monitoring program that addresses all hydrological units of the state using consistent, objective, monitoring, sampling and analytical methods, consistent data quality assurance protocols and centralized data management.

- Provide an umbrella program that monitors and interprets the data for each hydrologic unit at least once every 5 years.

- Document ambient water quality conditions in potentially polluted and non-polluted areas.

- Provide a program which encompasses a geographic scale ranging from site-specific to state-wide.

- Identify specific water quality problems preventing the SWRCB, the RWQCBs and the public from realizing the beneficial uses of the waters of targeted watersheds.

- Provide data to evaluate the effectiveness of water quality regulatory programs in protecting beneficial uses of waters throughout the State.

Status of the SWAMP Program

A report on the SWAMP program was presented to the State Legislature on November 30, 2000. The following summary is based on that report. Updates on subsequent developments are not incorporated into this report but should be determined to assess current status.

Methodology Components of the SWAMP Program

Major SWAMP activities are envisioned to include:

- Implementation of comprehensive environmental monitoring which focuses on providing information needed to effectively manage the state's water resources. SWAMP is an umbrella program that monitors and interprets data for each hydrological unit at intervals of at least once every 5 years. The program impartially looks at all state waters without bias to known impairments, i.e. the program attempts to establish an objective overview of water conditions irrespective of any prior knowledge about impaired water conditions.

- The program will set up consistent monitoring methods with respect to sampling and analysis, data quality objectives and centralized reporting. It will be adaptive to changing circumstances, built on cooperative efforts, established to meet clear monitoring objectives and inclusive of already available information. SWAMP will utilize scientifically sound monitoring design with meaningful indicators, comparable methods and regular reporting and data management.

- SWAMP will focus on spatial status and temporal trends in water quality statewide. Site-specific locations, areal extent and trends will be identified. It will include multiple measurable indices for water quality, sediments and biota that are widely applicable throughout the state. For

watersheds, a rotating basin framework will be implemented. For coastal areas, a smaller monitoring unit will be implemented.

- The SWRCB will develop a Water Quality Control Policy as a means to implement the program.

The SWAMP Monitoring effort is built around the following factors:

- **Adaptability:** California maintains a vast diversity of natural resources and surface water resources. Water resources include streams, rivers, lakes, estuaries, coastal lagoons, enclosed bays, wetlands and coastal waters. SWAMP's approach is intended to be readily adaptable to the varying scales of dimension and environmental resource values.

- **Clear objectives:** Clear monitoring objectives are essential in achieving meaningful and useful information. Also, due to the potential costs involved with monitoring programs, its clearly defined objectives help identify the most useful information for agencies and stakeholders

- **Use of Available Information:** Use of existing data is encouraged, with the condition that it serve its intended purpose and is of suitable quality. Sources can include: compliance monitoring data, regional monitoring efforts and other monitoring by federal, state or local agencies, volunteer groups, and universities.

- **Scientifically sound monitoring design:** All monitoring programs need to be based upon solid, defensible, scientific design. SWAMP will develop statewide templates as protocols that will be applied to the maximum extent possible.

- **Meaningful indicators:** SWAMP will use best available condition and response indicators of water quality. Indicators will be scientifically valid and practical, and meet the needs of the water quality program. Selected indicators will serve as evidence of the quality of biological resources and human uses

- **Comparable methods of sampling and analysis:** In order to compare information from different monitoring locations and programs, some level of consistency must be developed for the approaches and analytical methods employed, as well as stated minimum detected limits, measurement quality requirements and other quality assurance requirements.

- **Data evaluation:** Monitoring data will need to be evaluated in order to achieve meaningful assessments of status of water quality. Evaluation will use appropriate and meaningful benchmarks.

- **Data management:** Lack of standardized data management can greatly reduce the value and utility of information. SWAMP will utilize existing data to the extent they can be verified and placed or linked into centralized information hubs accessible by all stakeholders.

- **Regular reporting:** Monitoring reports provide feedback to the SWRCB & RWQCBs on the success of regulatory programs and strategies, pollution prevention activities and the cooperative efforts of stakeholders. These reports will be made available to all interested parties.

Subjective Evaluation of the SWAMP Program

SWAMP is intended to provide a framework to integrate and standardize the monitoring efforts undertaken by the SWRBC & the RWQCBs. With its broad range of spatial applicability (it is planned to adapt to multiple scales, such as a region or watershed or to a small site), the logistical steps for creating such a data system will likely be challenging. especially as is intended to be useful from the micro to macro-scales Designed to make useful information about the current status and future trends of water quality available to the public and interested parties, SWAMP seems to be an extremely important program for parallel programs such as CCRISP.

It is anticipated that an approach based on cooperation and collaboration will reduce costs. The cost of monitoring is anticipated to be high due to the scale of the effort and the cost of analysis. The most cost effective approaches are those that bring together all stakeholders to jointly design and implement the program.

Broader Applications of the SWAMP Program

It is proposed that SWAMP coordinate closely with the NCWAP (North Coast Watershed Assessment Program). SWAMP monitoring will benefit both the NCWAP and TMDL (total daily maximum load) programs, in the assessment phase as well as in the follow-up phase. The rotation schedule of SWAMP's intensive basin surveys will be closely coordinated with the NCWAP assessment schedule to provide additional and current information on water quality parameters to the NCWAP assessment. SWAMP methodology will be used to collect field data in NCWAP as needed. Because of parallel alignments of purpose, objectives and scope with CCRISP, SWAMP would be a good point of departure for CCRISP's assessments of aquatic resources.

Overview of the California Natural Diversity Data Base (CNDDB)

The California Natural Diversity Data Base is a program established in California in 1979 as a component of The Nature Conservancy's (TNC) International Heritage Network. Initiated as a partnership between TNC and the Resources

Agency Department of Fish and Game (DFG), the CNDDB tracks site occurrence information on a host of sensitive plant, animal and fish species, and on important natural communities throughout the State. Such information is used extensively in environmental review and in developing priorities under the DFG's Significant Natural Areas Program (SNAP). The CNDDB provides valuable site-based information that can be used with other data layers to assess the current health and condition of some of the State's most sensitive species, and the habitats upon which they depend. In this context, it should become an important component of the CCRISP effort.[7]

Basic Questions Addressed

Basic questions addressed by the CNDDB are:

- What are the state's rare and sensitive plants, animals and natural communities (called "elements" of natural diversity)?
- Where are the known locations of these elements?
- What are the status and condition of these elements and their habitat at these locations?

Goals of the CNDDB Program

The program's primary goals are:

- To provide the most current information on the state's most imperiled elements of natural diversity.
- To provide tools to analyze these data.
- To acquire, integrate, improve, and distribute spatial and textual information on the state's rare and sensitive plants, animals and natural communities.
- To provide this information internally to the DDFG, to other public agencies, private organizations and to the public for making informed conservation decisions.

Status of the CNDDB Program

The CNDDB Program is an ongoing effort housed within the Department of Fish and Game. It is used extensively as a tool for California Environmental Quality Act (CEQA) compliance.

[7] The following summary information was derived from a survey response from Joe Carboni, Research Manager I, Wildlife Habitat and Data Analysis Branch of the Department of Fish and Game, and from information retrieved from the CNDDB website at www.dfg.ca.gov/whdab/html/cnddb.html

Methodology Components

The CNDDB follows the Natural Heritage Network's Methodology. This Network is now overseen by the Association of Biodiversity Information (ABI), a spin off organization of The Nature Conservancy, established to support development of tools and science for the conservation of biological diversity. Data are received from multiple sources, but seldom from CNDDB staff, since CNDDB is consumed with data analysis and entry. Once data arrives, CNDDB logs, analyzes, and enters it into a GIS and Oracle database as location records. Products are later produced and distributed digitally and in hard copy form.

Some of the key indicators used for assessing resource or habitat condition include:

- The current status (e.g., rare, threatened, endangered, species of special concern, etc.) of selected species; and,
- Site specific information based on the data contained in the source documents received and processed by the CNDDB and supported by published literature, coordination with species experts, etc.

The CNDDB Field Survey Form used to collect data contains a "site condition field" whose use is encouraged. Under this category, field observers can grade a site as A-D (Excellent, Good, Fair, Poor), based on the amount of visible disturbance. Accompanying text fields allow the observer to include details on the land use, threats and disturbances, if any. CNDDB staff use these and other data components to develop a "site rank" for each location entered into the computer database.

The data categories used in determining habitat/resource condition are:

- The particular species (called an element) being addressed.
- The site, and the element at that site, which are ranked as "A"- excellent, "B"- good, "C" - fair, "D" - poor, "X" - extirpated, or "U" - unknown (meaning that the source documents did not provide any information).
- Population size, habitat disturbances or destruction, pollution, exotic species, etc.
- 34 different threat types, which are coded and can be easily queried by the users of Rarefind 2, the PC-based program that interprets the data and provides responses to specific questions that might be asked about the data.

The data is screened in a variety of ways. CNDDB staff biologists review all incoming data. For plants, where identification is sometimes problematic, data are reviewed very closely, and out-of-range locations challenged and confirmed (through email, phone conversations, checking of specimens, etc.). Users also screen the data through a feedback mechanism. In other words, one of the advantages of making such data readily available is that the users contact CNDDB staff when data are incorrect.

Data screening is based on the following criteria:

- Is this a taxon tracked by the program? (Many common species are not tracked by the CNDDB)
- Does it meet the element occurrence definition? (i.e. for some birds we map only the breeding locations)
- Is it precise enough to map?
- Is it in the right habitat?

Species identifications, especially of plants, are often checked using the latest flora publications. Occasionally, experts are consulted.

While there is no formal peer review component for location data, CNDDB lead biologists perform a quality control check on every record that gets entered. In addition, there is extensive review that occurs prior to adding, deleting or changing the names of species occurring on the lists of special plants and animals.

Particularly for plants, there is extensive peer review. The botany peer review for the Special Plants List includes review by academics, local experts, consultants and anyone with knowledge of specific taxa.

The CNDDB does not have a formal field verification protocol, but relies on the expertise of its biologists and other review mechanisms.

The methodology addresses the effects of human interaction and impact on biological resources through its documentation of the current land use (e.g., documentation of human related activities such as grazing, Off Highway Vehicle (OHV) use, roads, development, agriculture, logging, etc.), and characterization of existing habitat quality. As an example, light disturbance such as light grazing, dirt roads, etc. would likely brings an “A” ranked site down to “B”. More extensive disturbance such as OHV use, grading, heavy grazing, etc. would reduces the site rank to “C” or “D.””

The CNDDB program uses the spatial scale of 7.5-minute USGS topographic maps, but the data can be displayed at any scale.

The temporal scale is as broad as the data will enable it to be, with the oldest record dating from 1842, to the most current records in 2001. The updating process is continuous and ongoing. The methodology is applicable to any landscape types upon which the taxon that are tracked occur.

Subjective Evaluation of the CNDDB Program

The CNDDB provides extensive information on rare and sensitive species to a large number of clients on a regular basis. Data are provided in a variety of formats from digital to hard copy.

Program strengths include the fact that every source document used is contained in a related database, so that the end user can see every piece of data used to create that "element occurrence". In other words, the data are extensively referenced. In addition, the data is consistently interpreted and mapped, and every feature is quality controlled by senior biologists. Information is gathered from a wide variety of sources and made available in a standard output format. Data is spatial, therefore the user can make geographically based queries. And, as mentioned above, the special species lists are extensively reviewed and checked by outside peer reviewers, especially for plants.

Program weaknesses include the fact that there are gaps in the data where there have been no surveys or where the information has not been available for entry into the CNDDB. Also, because CNDDB is a positive sighting database, users sometimes misinterpret the data to mean that lack of mapped occurrences within their area of interest means there are no rare or sensitive elements within that area (even though this is explained in a disclaimer). The CNDDB methodology is time-consuming, though precise and accurate.

Suggested modifications to the program include:

- Improving capability to keep up with the flow of incoming data.
- Reestablishing an aquatic community component of the CNDDB.
- A stronger outreach program aimed at soliciting new and updated information on a regular basis.
- GIS training or ready access to regional GIS specialists and computers powerful enough to handle the CNDDB software, RareFind2 for Department and other users.
- Added GIS and other computer capability are required to stay abreast of changes in technology and to better serve client needs.

Broader Applications and Adaptability of the CNDDB Program

Broader applications of the CNDDB methodology include using the sensitive species and natural communities data, in conjunction with other applicable data sets, to help identify and design a statewide conservation strategy. One of the basic functions of the Heritage Data Bases, as originally conceived, was to use

this information in identifying important sites for conservation action. In the context of developing landscape-based conservation planning initiatives, the CNDDB houses an important component (locations of sensitive resources) of the information that should support these efforts.

III. Other Organizations or Agencies

The following summary describes several non-governmental programs which have biodiversity conservation and/or ecosystem management as a central core of their efforts. Included in these are two projects of The Wilderness Coalition, Conservation Area Design Program and the Ecosystem Management Decision Support Program; the efforts of The Association for Biodiversity Information; The Nature Conservancy, Eco-Regional Conservation Planning Program; and The Oregon Biodiversity Project.

One private-based program, the Idaho Ecosystem Management Project, was reviewed but not included in this report. Initiated in 1994, by Boise Cascade Corporation, this was a collaborative ecosystem management project aimed at demonstrating ecosystem management techniques on over 3-million public-private owned acres in Idaho. Similar projects were initiated in Washington State and in Minnesota. This program was not included because its status is currently on hold, due primarily to inadequate funding.

Conservation Design Methodology (CAD)

The California Wilderness Coalition developed the Conservation Design Methodology (CAD) for the central coast range of California based on the Ecosystem Management Decision Support (EMDS) Methodology. Although it does not establish the parameter of resource health and condition as a primary variable being assessed, what can be derived from the CAD and EMDS methodologies are the creative means for supporting long-term management and acquisition strategies that rely indirectly upon an indication of the condition of the overall resource. In the CAD methodology, “one of the major assumptions of using wide ranging focal species to define potential conservation designs is that, if protected, these species will protect many other species due to their extensive spatial requirements” (Noss & Cooperrider, 1994, Simberloff, 1998). Conversly, the indication of decline of these selected focal species provides a window to the health of the resource and a measurement of the viability of the protection strategies. It should be noted that there has been some debate on the efficiency with which focal species represent other taxa in conservation plans (Andelman & Fagan, 2000)”.

Basic questions addressed

What optimum configuration of protected lands should be protected or restored to accommodate an identified list of species and elements of concern? And indirectly, what lands when protected, provide safe habitat for all native species and natural processes? How to achieve the "rewilding" of identified critical landscapes?

Goals of the CAD Program

The principal goals outlined for the CAD program include the following:

- Provide a framework for making decisions regarding habitat protection and preservation for selected key species.
- Provide a framework for making decisions regarding habitat protection and preservation at a landscape ecosystem level.
- Enable a "transparent and replicable" decision making process.
- Easy updating and independent testing of both individual and group species design.

Status of the CAD Program

This program is currently in a formative stage with pilot features under development for field-testing investigation.

Methodology Components of the CAD Program

The Conservation Design Methodology is designed around an additive model, based on a comparative or representation analysis of a variety of species and elements of special concern against a biological network of proposed managed areas defined from modified ranges of five focal species. The focal species were selected for their large spatial requirements and for their utilization of a variety of habitats.

The CAD design relies on a modular form of data organization, intended to make decisions transparent and replicable (See Attachment). This format is designed to facilitate updates and to permit independent testing of both individual and grouped species designs. Data is organized into four different informational quadrants:

- Human perturbations: including roads, housing, miscellaneous human related maps and landscape classifications such as the National Land Use Data Base.
- Biological and physical data: including identified focal species, vegetation data and other specific biological data.

- Human build-out and Fragmentation Models: including urban expansion, vineyard expansion, projected logging activities and other proposed land use changes.
- Conceptual Biological "Rewilding"/restoration models: including biological predictions, biological prescriptions, species reintroduction, fire management, native planting exotics removal, etc.

Three categories of biological elements are assessed and tracked:

- individual species
- species/habitats that represent habitat for a specific groups of species
- areas that contain unique combinations of species

Spatial scale is typically watershed level assessment. Grid type coverages, created with a range of resolution from 100 to 200 meters, have been incorporated. Historic bench marking is established through historic distribution mapping, when and where available. This historic reference information can include records of forest fires and their frequency. A typical benchmark standard is the hypothetical pre-Spanish contact condition of a particular resource or resource area.

Data collection, screening and entry remain the greatest challenge to full implementation of the CAD program. One strategy for accelerating the consolidation of data for the CAD program is stitching together other regional plans built upon similar data information. Verification of data accuracy looms as a primary issue with this approach.

Subjective Evaluation of the CAD Program

The CAD program appears to be very promising with regard to the development of CCRISP methodology. The organizational structure of the CAD assessment model allows the logical sorting of significant variables that can impact a given resource area.

Broader Applications and Adaptability of the CAD Program

The model seems to provide relevant contributions for determining causative relationships affecting the status and condition of resources, as well as a defendable basis for making proactive decisions for resource management. A notable limitation is the current lack of on-the-ground examples of its performance, but with sufficient time for testing and adjustments this limitation will be diminished. Conceptually, the CAD program has been developed for broad stakeholder use.

Re-Wilding the Sierra Nevada, Methodology for Wildland Mapping

The second California Wilderness Coalition program to be considered in this report is the Re-Wilding the Sierra Nevada, Methodology for Wildland Mapping. Like CAD the Re-Wilding mapping methodology is based on the Ecosystem Management Decision Support (EMDS) methodology. It too approaches the parameter of resource health and condition indirectly.

Basic questions addressed

What optimum configuration of protected lands should be protected or restored to accommodate an identified list of species and elements of concern? And indirectly, what lands when protected, provide safe habitat for all native species and natural processes? How to achieve the "rewilding" of identified critical landscapes?

Goals of the Program

The principal goals outlined for the Sierra Rewilding Program include:

- Maintain or restore viable populations of focal species
- Maintain or restore connectivity for focal species and natural processes
- Represent all native ecosystem types and successional stages across their natural range of variation in a network of protected areas

Status of the Methodology for Wildland Mapping Program

This program is in a formative stage.

Methodology Components

Program goals involve focusing on a "combination of focal species' habitats, unfragmented landscapes, and essential connecting and ecologically-critical areas." This program is GIS supported through the specific application of the GIS extension program Ecosystem Management Decision-Support (EMDS) (Reynolds et al. 1996, Reynolds, 1999). The EMDS consolidates at least 26 different sets of spatial data for the Sierra bioregion. This is achieved through the use of a knowledge base built upon three primary concepts:

- Ecological value
- Actual development
- Threat potential

A scoring system is derived from the three primary concepts and then applied to a one kilometer grid cell level of resolution. This information provides the basis for a landscape level evaluation of each cell, with respect to its contribution to the conservation of biodiversity and "wildlands". A second analysis is then applied, using an annealing process through which grid cell values are "clumped" together to create "core [value] areas". Finally, a "Least Cost Path" function identifies the

optimum corridor connections between these core areas. This network is being tested to meet several expectations:

- Representation of plant communities within the network.
- Quantification of the overlap between the network and the focal species habitat maps.
- Calculation of the proportion of roadless areas, and other areas of interest, within the data system.

The human perturbation factors are quantified in terms of assessing human impacts and the potential for ecological integrity of the landscape (terrestrial and aquatic). Several surrogates have been selected for estimating the degree of threat to ecological processes and features from human activities. These include: roads, county parcel data, county general plan and zoning information, public and private ownership, and the presence of dams and reservoirs. Road effects are measured in terms of proximity to streams, fragmenting "habitat" into patches, and other disturbance (e.g., from traffic). County parcel and general plan designation of use densities serve to indicate actual or potential development (including logging, recreation, rural agriculture, and housing). Ownership complexity is also considered as a variable for determining resource risk and as an impediment to resource connectivity.

The EMDS model was created by the U.S. Forest Service Pacific North-West Research Station as a tool to help resource managers make informed decisions about landscape processes. EMDS links the GIS –based mapping/data system and the knowledge base creation program "Netweaver" (Saunders, 1990). Netweaver is an object-based hierarchical network, with nodes calculated based on fuzzy logical relationships. EMDS provides Netweaver with the necessary GIS base data, using fuzzy logic rules to determine degree of truth for an assertion (Reynolds et al. 1996 and Reynolds 1999a,b).

As described above, the spatial scale is a landscape level assessment. The highest resolution, publicly available information is used for this analysis including data sets from the U.S. Forest Service, U.S. Census Bureau, ICE at UC Davis, CA GAP analysis, and others. Focal species data and other boundary and reference data are being collected from various sources.

Similar to the CAD Program, data collection, screening and entry is a primary challenge in achieving program objectives.

Subjective Evaluation

Like the Coastal CAD Assessment Program, the Re-Wilding the Sierra Nevada Methodology for Wildland Mapping is also relevant to the development of CCRISP methodology. The model is clearly intended to address a landscape level assessment; and the indices for determining the degree of human threat would seem to be applicable to an on-going program for assessing the health and condition of a given resource. The organizational structure of the EMDS allows evaluation of a complex set of variables for a given resource area. Not apparent in this evaluation is the specific process by which relative weighting and

subjective comparisons are made between the disparate data sets in the determination of values, risks and priorities.

Broader Applications and Adaptability of the Program

The model seems to provide relevant contributions for determining the causative relationships affecting the status and condition of resources as well as providing a defendable basis for making proactive decisions for resource management. The stitch work approach of building on to multiple data sources found within regional plans, serves as an example of how a statewide health and conditions program could be created without starting from scratch.

Program Overview of The Nature Conservancy's Eco-Regional Planning Program

The Eco-Regional Conservation Planning Program was established to identify biological conservation priority areas, in order to support the Nature Conservancy's greater mission of "saving the last great places". The program identifies priority areas by assessment at a coarse scale. Following "eco-regional conservation planning", a finer process of "site based planning" is conducted before The Nature Conservancy (TNC) takes conservation action. [8]

The Nature Conservancy designed the program in-house for internal use, as well as for use by private or public conservation partners. The program has been used, for example, at the county level in a stakeholder process. Some of the information is proprietary in nature, although it is not clear at this point how that information is handled.

Although the primary agenda of The Nature Conservancy is not the assessment of the health and condition of natural resources, it appears that this assessment is an integral component of program considerations. Therefore, the Eco-regional Planning Program may be relevant to CCRISP's resource assessment methodology.

Basic Questions the Nature Conservancy's program is trying to Answer

What are the areas that deserve priority conservation action?

Goals of the Eco-Regional Conservation Program

"The Nature Conservancy's goal is the preservation of plants, animals, and natural communities that represent the diversity of life on earth by protecting the

[8] The following information, highlighted by the text in quotations, is based on a survey response and telephone conversations with Craig Mayer, Associate Director of Conservation Planning with The Nature Conservancy.

lands and waters they need to survive." The goal of the eco-regional conservation planning program is to identify priority biological conservation areas for further analysis using site based planning, which may ultimately lead to conservation action by the Nature Conservancy.

Methodology Components of the "Eco-Regional Planning" Program

Process:

- Identify conservation targets (species of communities) by eco-region.
- Set goals for number and distribution of targets protected.
- Assemble information and data regarding location and quality of targets.
- Design a network of conservation areas to meet goals.
- Select high priority areas for The Nature Conservancy action.

The data categories used to determine habitat or resource condition include "occurrence information (i.e. mapped data from GAP, Calveg, CNDDB, FRRAP, etc.), expert interviews, site visits, and literature."

The key indicators used to determine habitat or resource condition include population size, size of area, condition or health, and landscape context.

The spatial scale is typically 1: 100,000 for eco-regional planning. The methodology was designed for eco-regions, but can be scaled to county or statewide levels. Eco-regional plans are updated every 5-10 years. The methodology utilizes the most current and/or accurate data available. Data older than 20 years is culled out. At this time, there is not enough information to determine how data is screened and verified by The Nature Conservancy.

The effects of human interaction with natural resources is incorporated into the methodology by analyzing data on road density, land use and landscape context.

Peer review involves interviewing key or knowledgeable individuals during the process, and a selected review of the final product. The Nature Conservancy Conservation Planning staff also conducts an internal review. The protocol for field verification involves a field check of the conditions of the high priority areas, which have been identified prior to TNC action.

The Respondent's Subjective Evaluation of the "Eco-Regional Planning" Program

The respondent was very optimistic about the usability of the "eco-regional planning" approach, stating that it was "very usable, effective, and timely". It was further stated that the methodology is able to build on existing data, is cost effective, and useful in setting priorities. An admitted weakness of the methodology is that it "requires detailed planning at a finer scale before action

can be taken." The respondent had no suggestions for modifications to improve the approach.

Broader Applications of the "Eco-Regional Planning" Program

The respondent was of the opinion that the methodology is applicable to other State assessment programs, since it uses "accepted conservation planning techniques to quickly identify priority areas." The program provides updates every 5-10 years, and is adaptable in that "priority areas are updated periodically through site planning."

Program Overview of the Oregon Biodiversity Project

The Oregon Biodiversity Project (OBP) was initiated in 1992 by Defenders of Wildlife, a nonprofit organization, in collaboration with state and federal agencies. OBP was founded in response to an identified need to provide a statewide assessment of Oregon's natural diversity, current trends, and a to provide a vision for the future. It looks across the entire landscape, relying on the contours of biological form and function with political boundaries as a secondary feature.

The OBP has generated products and processes useful to a wide variety of stakeholders and interests, both within and outside of Oregon. As part of its effort, the project produced a "process" report that, along with the other primary products (an atlas and an incentives report), is being utilized as a model by other states as they begin to initiate landscape-based initiatives of their own. Whether or not the specific approach used by the OBP is adopted elsewhere, components of the project and the process undertaken will continue to influence efforts around the country.

Assessment of the health and condition of natural resources has, to date, been more or less a subjective component of the OBP. Like most of the newly emerging landscape-based conservation initiatives around the country, assessing health and condition will be a part of program implementation, and of monitoring into the future. Basically, the OBP, like many other developing programs, considers the "future desired condition" to be more important than the current condition, and directs limited resources toward improving that future condition. Measuring the change in health and condition over time will provide an assessment of their success or failure toward achieving that end. A potential application to CCRISP that OBP raises the question of how best to approach California's interest in understanding the health and condition of the State's natural resources, and when such an understanding is of most importance given a limited availability of both human and dollar resources. In other words, is the best investment in determining the current health and condition of our natural resources, or in monitoring the changes in health and condition as we move toward a defined future desired condition, or both?

Basic Questions of the Oregon Biodiversity Project (OBP)

The basic underlying question of the Oregon Biodiversity Project is how can the state develop a better understanding of the context for its biological landscapes, along with the challenges that Oregonians face in trying to conserve biological resources while still meeting economic and social needs?

Goals of the OBP

The primary goal of the OBP is to develop a big picture view of biodiversity conservation needs and opportunities in Oregon, and how to develop strategies to address these needs and opportunities.

Status of the OBP

The Oregon Biodiversity Project is an active and ongoing program and is being used as a model for other landscape-level conservation initiatives around the country.

Methodology Components of the OBP

The primary methodology employed by the OBP involves looking at the status and distribution of native habitats and at-risk species, and includes an assessment of changes from historic conditions. Key indicators used include the presence or absence of native vegetative communities, and locations of special status species and native habitats in relation to lands managed for conservation purposes. From this assessment came the identification of 42 Conservation Opportunity Areas across the state that reflect a cross section of Oregon's biological diversity.

A key component of the project is the Oregon Biodiversity Information System, a GIS-based set of linked, electronic databases that brings together numerous biodiversity-related data sets that have been compiled into consistent and compatible computerized formats. The data sets reflect the best information available in statewide coverages that could be compiled in consistent GIS formats. Ecological data include current and historic vegetation; distribution maps for more than 400 terrestrial vertebrate species; hydrology; land forms; locations of rare, threatened, and endangered species; healthy salmon stocks; aquatic diversity areas; and a variety of other features. Human-related data include information on land use and ownership; roads; classification of lands for biodiversity management; population and demographics; socioeconomic information; and political boundaries.

The optimum spatial scale for the program is statewide, although the information was developed at an eco-region scale and is also usable at an eco-regional scale. The program currently is using 1990 imagery and comparing it to historical data as such data is available. While the OBP focus is on long-term

biodiversity protection, it is estimated that the data will need to be updated every 10 years or so to keep it relevant to changing conditions in Oregon.

There is currently relatively little data screening, and nothing formal within the program. The use of data sets was in part determined by whether they could be placed in compatible formats. Very basic screening included a preliminary assessment of whether data was useful to help answer the questions being asked and whether it "seemed" accurate. Wherever possible, metadata was used to support primary data sets. Metadata was created for some data sets.

Subjective Evaluation of the OBP

The OBP is intended to be applicable to multiple types of landscapes. Primary limiting factors of the program include the availability of usable data and the fact that the process is very data intensive. This can place difficult demands on computer capability.

At this point the OBP does not have a formal peer review component in the context of publications in peer-reviewed journals or an independent peer review committee. All products were independently reviewed prior to their production and there is continuing feedback to the program. Likewise, to date there has been little field verification related to the program. Data sets utilized by the project have various levels of field verification associated with them.

Primary strengths of the OBP include the fact that it is usable by a diverse set of stakeholders and other interests. Its simplified view of conservation needs and opportunities makes it understandable. And, it is still one of the few statewide models available for use by other states or regional planning interests. In addition, it has helped educate many, both within and outside of the state, about biodiversity issues. In Oregon, it has established biodiversity concerns as a legitimate issue of debate in Oregon policy and has changed the tenor of the discussion surrounding these issues.

One of its primary strengths, its simplicity, is also one of its major weaknesses. It is just too simple for some applications, most notably, those at the local or site level. At best, it is most applicable at an eco-regional level. The program also did not directly produce an implementation plan for preserving biodiversity in Oregon. Rather, it identified a process and needs. Lastly, the OBP did not address the full scientific assessment of what is needed to fully conserve the state's biodiversity. For example, it did not involve an assessment of what is required for the long-term conservation of species with large home ranges that likely include areas outside of the identified Conservation Opportunity Areas.

Modifications to improve the OBP might include creating a greater linkage to a broader spectrum of species, that combined, more completely represent the state's overall biodiversity. Improved analysis aimed at dealing with species with

large home ranges should also be a consideration. Also, it appears to not address the health and condition of already protected and unprotected lands, and doesn't provide advice on how to address those problems.

Broader Applications of the OBP

As mentioned, the Oregon Biodiversity Project products and processes are being used as a model nationwide as more states begin to initiate landscape-based conservation programs. In April of 2001, the OBP served as the basis for a workshop sponsored by the Department of Defense held outside of Nashville, Tennessee. What helps greatly in the broader application of the OBP is the fact that the program produced quality products that can be used to help educate others and provide them with a set of conservation planning tools that have, until now, been relatively unavailable.

Program Overview of Association for Biodiversity Information (ABI)

The Association for Biodiversity (ABI) is a not-for-profit organization dedicated to developing and providing knowledge about earth's natural diversity. ABI collaborates with 75 independent natural heritage programs and conservation data centers that gather scientific information on rare flora, fauna and ecosystems in the United States, Canada, and Latin America, including the California Natural Diversity Data Base (CNDDB).

ABI was formed in July 1999 when the Nature Conservancy and the Natural Heritage Network mutually established an independent organization to advance the application of biodiversity information used in conservation efforts. Even though ABI is a new organization, its database, staff, and expertise reflect more than 28 years of experience. ABI is currently launching a groundbreaking project to create a new set of software and information tools called a "decision–support system" which will help make complex scientific information accessible to people in communities who wish to protect local biological diversity.

Since the assessment of habitat and resource conditions is central to ABI's methodologies, the ABI program has a high degree of relevance to CCRISP.[9]

Basic Questions the ABI Program is trying to Answer

ABI is structured to answer the following questions: Which elements of biodiversity (species, communities, ecosystems require conservation action? What is their conservation status (degree of imperilment)? Where are they located, and what is the relative conservation priority of those occurrences and the sites in which they occur?

[9] The following information, highlighted by the text in quotations, was taken from a survey response by Alan Weakly, Chief Ecologist, ABI

Goals of the ABI Program

The goals of ABI are to "develop, gather, manage and analyze information on biodiversity and provide it in a useable form to conservation decision-makers (such as) nonprofit conservation organizations, federal agencies, state and provincial agencies, local agencies and local land trusts, etc. so that it can inform land use and other conservation-related decisions."

Methodology Components of the ABI

"The Association for Biodiversity Information (ABI) has a detailed and standardized set of methodologies that have been developed and improved over a 28+ year period. ABI is structured with central / regional offices which coordinate the development of methodologies and standards, develop 'central' information on biodiversity elements, and coordinate with state-, province-, and country-based Heritage Programs and Conservation Data Centers throughout the Western Hemisphere. The individual programs (such as CNDDB) gather information on a state level, which then feed back into regional, national, and international data sets, information and analysis. Methodologies include standard biodiversity ranking methodologies, database and GIS mapping techniques, standard taxonomies for plants and animals, development of and application of a hierarchical classification of ecological community types, survey methodologies, and standard methodologies for defining occurrences and ranking the quality and viability of occurrences of the species or community."

Some of the key indicators for assessing resource or habitat condition include: "occurrences of ecological communities and imperiled species, and assessments of the quality and viability of those occurrences".

The ABI model utilizes "a complex set of methodologies for assessing habitat/resource condition. The central methodology is termed Element Occurrence Ranking. Most of these methodologies require ground survey and qualitative and quantitative assessment of the size, extent, quality, condition, and landscape integrity of the element in question. [ABI is] increasingly developing remote-sensing techniques that evaluate the communities present, and their degree of integrity." The data undergo "rigorous quality control at several scales and at many points in the data management process. [For example,] documentation of the identity of the element is strongly encouraged (such as collection of a voucher specimen of a rare plant species, or of standard plot data for a community). Data sets are screened for spatial errors and individual data records (undergo quality control procedures). The Network is known for its attention to detail and quality control, lest expensive land use decisions are made erroneously."

The methodologies used have been developed to address all landscape types. Sometimes, methods are customized to fit local conditions and situations, as needed.

“There area a variety of methodologies appropriate for use at different scales. More detailed, and ground survey-based methodologies have historically been the major focus, but [ABI is] expanding into broader scale methodologies utilizing remote sensing and GIS modeling.”

The temporal scale that the methodology addresses focuses on “maintaining as accurate as possible, a current snapshot of biodiversity condition and priority. Temporal monitoring is handled loosely, although obtaining trend data is a growing area of attention.”

Peer review takes place in the following manner, “ABI and the individual Heritage Programs and Conservation Data Centers operate as a network of peers who interact regularly. ABI and its components also have strong interactions with the academic and agency science networks (that) regularly review data and methodologies… The National Vegetation Classification (NVC) is developing an explicit interaction with the Ecological Society of America to refine and implement classification standards, and to provide explicit peer review of the NVC.”

Field verification protocol is a very important component of the methodology. “Most assessment methodologies in use by ABI and its constituent programs are primarily based on field techniques, and are based on actual, detailed documentation of the presence, quality, viability, etc. of the biodiversity element.”

The methodology incorporates the effects of human interactions and impacts on biodiversity. “In the more basic methodologies employed, these are qualitatively assessed by the field surveyor, and incorporated into an Element Occurrence Rank (EO Rank), which is an integrated assessment of the quality, condition, size, and viability of the occurrence. The latter subcomponents of EO Rank are also often separately tracked in the databases. More remote-sensed methods sometimes utilize modeling of landscape patterns (road density, fragmentation, incompatible land uses) as components in assessing the biodiversity values of the area.”

The Respondent’s Subjective Evaluation of the ABI

The respondent’s assessment of the strengths and weaknesses of the ABI approach were as follows: “There are, of course, different merits of ground survey and remote-sensed methodologies. At ABI, our emphasis has traditionally been on ground survey, as it provides verified information of high accuracy and certainty. However, ground survey is costly, is rarely spatially comprehensive, and is difficult to redo regularly. Remote sensing solves those problems, but has its own downsides, especially that many biodiversity elements cannot be surveyed in this and there is uncertainty and about the generality of the information gathered. We believe that a complementary approach of using a range of methodologies can produce the most robust and useful biodiversity data

layer." The problem with the complementary approach is that "limitations on the resources available to different component programs means that data are developed more or less comprehensively in different areas."

Broader Applications of the ABI Program

The program was designed "largely in-house, with considerable stakeholder input" for broader stakeholder use. The intended end users are decision-makers at all levels, and in a range of organizational settings (governmental, NGO, land manager, academic, and public). The methodology is applicable to other State assessment programs in that "it is in extensive use through most of North America in all 50 states, all Canadian provinces, and in regional and sub regional (e.g., National Park) assessment settings. The methodology is explicitly designed to do state assessments and to develop conservation assessments and plans. New components of the ABI methodologies will allow an ever more enhanced capability to deliver this information."

Some of the information is proprietary in nature. For example, "Information on the locations (occurrences) of some biodiversity elements has security concerns. Sometimes information is screened, withheld, or geographically or taxonomically generalized, depending on the user."

According to the respondent, "the program is robust and has a history of innovation and renewal. New methodologies are developed through a team process involving central, regional, and local staff, and often by additional stakeholders or users. It has more or less continuously evolved since its inception in the early 1970s, but ABI is currently implementing a fifth major revision to its data management structures, including much more extensive and integrated use of GIS. Other methodologies are also being reworked based on feedback from clients and users in an adaptive management approach. One need is to improve the methodologies for integrating complex biodiversity information into integrated locational or site priority scores."

IV. Other State and Federal Programs

The following summaries describe several state (outside of California) and federal programs that have biodiversity conservation and/or ecosystem management as a central core of their efforts. Our charge was to consider what other states and federal agencies were doing to assess the health and condition of natural resources. Included below are summaries of efforts from Illinois (Critical Trends Assessment Program), Florida (Closing the Gaps Program), and the U.S. Forest Service (Sierra Framework Program and Large Scale Watershed Program).

It should be stated that there are numerous emerging efforts around the country that attempt to take on the challenge of true landscape-scale conservation planning. This report must be considered a work in progress, and the summaries

contained within will be updated as new information becomes available. Pennsylvania for example, in developing their "Biodiversity Partnership Program", is at a similar point in the development of their statewide initiative as is California. Their first Partnership meeting is scheduled for early May of this year. In addition, Massachusetts and New Jersey are developing new statewide efforts. The U.S. Bureau of Land Management is also pursuing a major multi-state ecosystem initiatives in the sagebrush and prairie grasslands ecoregions of the intermountain west and central prairie states.

Program Overview of Illinois Critical Trends Assessment (CTAP)

The Critical Trends Assessment Program first published *The Changing Illinois Environment: Critical Trends* in 1994. *The Inventory of Resource Rich Areas* followed in 1996. These reports summarized the status of Illinois' ecosystems and projected future trends. During this same time period, the Illinois Department of Natural Resources initiated "Conservation 2000", a $100 million ecosystem-based, locally driven program to protect, enhance and recover natural resources on a landscape scale. Currently there are 34 local Ecosystem Partnerships covering about 70 percent of the state. The C-2000 Program provides on average about $4 million a year in grants to the Partnerships to implement projects that will enhance natural resources in their watersheds.

Information collected by CTAP is primarily used in correlating trends between monitored sites. This is seen as particularly valuable when comparing similar habitats in urban and rural areas of the State. The information is also important when considering ecosystem fragmentation issues and in tracking the expansion of non-native plant and wildlife species. Elements of the CTAP methodology may have application to CCRISP. For example, one of the primary challenges in assessing and/or monitoring the health and condition of California's natural resources is how to accomplish such a large task. The process established by CTAP to monitor many sites across the state on a regular basis, through the use of both scientist and citizen teams may provide a good and cost effective model for California.

Basic Questions the CTAP Program is trying to Answer

What information and actions are needed to help the State better address the complex problems it faces in making environmental policy on a sound ecological basis? What are the trends in natural resources and what are the trends in those factors (social, economic, etc.) that affect natural resources?

Goals of CTAP

The primary goal of the Critical Trends Assessment Program is to assess the state-of-the-environment by assessing the status of the State's biodiversity. This assessment is an ongoing process that analyzes trends in natural resources and

in the factors affecting those resources. It then facilitates programs aimed at maintaining or restoring biodiversity components.

Status of CTAP

CTAP is an active and ongoing program.

Methodology Components of CTAP

The CTAP utilizes teams of professional scientists and volunteer "citizen scientists" to monitor and assess over 150 sites across the state. Professional scientists sample 30 sites per year across 4 primary ecosystem types (streams, forests, prairies and wetlands), so that each site is sampled once every five years. Monitoring by citizen scientists is conducted through a program called EcoWatch, and on many sites, is carried out annually. Data collected by both groups has been compared for quality and accuracy. These comparisons show a high correlation between the volunteer collected information and that collected by the professional scientists. The monitoring effort combines numerous GIS data layers with other mapped information and field investigations.

The primary indicator used to assess condition is species presence. Monitoring is conducted for both plant and animal species, with emphasis on key indicator species identified by the program. Species are linked with the primary ecosystem type in which they are observed. The CTAP is intended to monitor trends and changes in these resources over the larger watersheds within the State, and to compile scientifically supported and analyzed data on each site at least once every five years. Data screening is carried out by program scientists who provide the primary quality control check for the effort.

Subjective Evaluation of the CTAP

CTAP methodology is designed to be applicable to multiple types of regional landscapes. The primary limiting factors for effective use of the methodology involve funding and the number and availability of professional and citizen scientists to carry out the assessment program. Quality monitoring is both dollar and people intensive and, without guaranteed long-term funding resources, the capability to continue over the long-term is in doubt.

The CTAP does have a peer review component. Peer review is primarily provided by a scientific panel that oversees the program. Participating scientists regularly have the opportunity to provide comments and recommendations for improving the effort.

Field verification protocols are established by the participating scientists and data quality is monitored and assessed. EcoWatch "citizen scientists" go through a specific training program prior to conducting field evaluations.

While the actual site monitoring effort is not focused on addressing human interactions with natural resources, some consideration of these factors is imbedded in the process. Potential human related threats, for example, were a consideration in the actual selection of sites. Within the monitoring program, the occurrence of non-native plants and animals is specifically noted.

The greatest strength of the program is its simplicity and streamlined data collection process. The "citizen scientist" component not only provides valuable resource information, but also engages a large cross-section of other stakeholders. The greatest weaknesses of the program are considered to be, first and foremost, the concern over long-term funding. Also, with a relatively high turnover in the "citizen scientist" component, it is sometimes difficult to gain the sustained commitment of volunteers, especially in urban settings.

Overall, the program appears to work extremely well. At present, the only major modification that the State would like to see is a commitment to a stable long-term funding source for the program. It is the translation of the program into actual investments in lands and natural resources that are monitored, beyond the funding of the monitoring program itself.

Broader Applications of the CTAP

Because of its relative simplicity and its proven record of success, CTAP methodology could apply to other regional or state assessment programs, depending on which types of questions and what goals and objectives these programs are intended to address.

Program Review of the Florida Closing the Gaps (Gaps) Program

The Florida Gaps program is aimed at identifying key areas in the state with conservation significance and that help to "fill in" the existing network of conservation lands. The state is currently reassessing the status of its program and is initiating efforts to update the data sets upon which it is based.

Primary methods of the Gaps program applicable to CCRISP are the use of: species models, identification of land changes over time, and use of spatial analysis to identify specific areas on the landscape to be targeted for conservation action (primarily acquisition).

Basic Questions the Gaps Program is trying to Answer

What areas of the state still need to be protected as part of a biodiversity-based conservation network of lands?

Goals of the Gaps Program

The goals of the Gaps program are to identify key sites in the state for land protection and acquisition. Goals also include the creation of species models for state and federally listed species and species of special concern that are then overlaid with other information in the site selection process.

Status of the Gaps Program

The Gaps Program is current and ongoing. The state is currently evaluating the program as part of a major updating effort.

Methodology Components of the Gaps Program

The basic methodology components of the Gaps Program are: the development of species models; identification of land changes over time; and the use of spatial analysis to identify specific areas on the landscape to be targeted for conservation action. Current condition is only very generally assessed on large spatial scale and involves consideration of historical locations for species and the degree of habitat loss.

The optimum spatial scale for the Gaps methodology is considered to be statewide. The temporal scale that the methodology addresses is between 10 and 15 years. There is currently little screening of data, and what is screened is done so primarily on an ad hoc basis.

Subjective Evaluation of the Gaps Program

The Gaps Program is intended to be applicable to multiple types of regional landscapes. Limiting factors associated with the program include its scale, which is too broad for more regional or local application. Also, the level of confidence in some data is of concern. Many of the species models are outdated and in need of updating. The land cover type maps currently being used are based on 1985 Landsat imagery.

While there has been some peer review of species models, this does not occur on a regular basis. The program is currently undergoing a review process that includes peer assessment in an effort to make it more current. Some field verification of data has been conducted, but again, without formal protocols.

Regarding use of the methodology to address human interaction with natural resources, the program is used to assess the impact of roads and other linear types of development.

The Gaps Program has enabled the assessment of land acquisition priorities and has provided direction to the state's acquisition program. Its primary use has been to focus acquisition priorities.

Program strengths include the fact that the information is available to, and is being used by, a variety of stakeholder groups, including local jurisdictions. Program weaknesses include its scale, which as previously stated is too large for useful analysis of regional or local areas. Another weakness is based on the fact that the information, and the Program has been continually challenged by those who feel it goes too far, or not far enough. In spite of the fact that it has been up and running for several years, there is still inadequate public understanding of the effort.

Areas of needed improvement include improving the species models and associated monitoring protocols, improving data input into species models, and updating the land cover types on a regular basis.

Broader Applications of the Gaps Program

As previously mentioned, the program is currently undergoing review in an effort to update it and make it more applicable to broader stakeholder needs. The basic philosophy and approach of this program is often used as a model for other developing efforts around the country. Updating the program and making it more user friendly for a broader stakeholder base should help bolster the Gaps program as one of the leading efforts in the nation. There also needs to be a broader evaluation of the conservation actions taken based on the program, and whether the program is indeed identifying the highest priorities for conservation.

Program Overview of the US Forest Service Sierra Framework Program

The Sierra Framework is a science-based program aimed at addressing five major problem areas in the Sierra Nevada region of California:

- Old forest ecosystems and associated species
- Aquatic, riparian, and meadow ecosystems and associated species
- Fire and fuels management
- Noxious weeds
- Lower westside hardwood forest ecosystems

The primary purpose of this effort is updating the Forest Plans on 11 National Forest in the Sierra Nevada. The methodology is designed specifically for various habitat components of the Sierra Nevada. It's application to CCRISP is that one of its basic functions is to assess land use changes over time, a primary component of assessing the health and condition of the landscape. The methodology is science driven and could provide a model for CCRISP to expand upon.

Basic Questions that the Sierra Framework is trying to Answer

The basic question the Framework attempts to answer is: How does National Forest management need to be modified to best address the five basic issue areas identified above?

Goals of the Sierra Framework Program

The basic goal of the Sierra Framework is the amendment of 11 National Forest Plans in the Sierra Nevada. The genesis of the Framework was the recognition that significant management issues could not be adequately addressed on an individual forest basis, or within individual forest boundaries.

Status of the Sierra Framework Program

The Sierra Framework Program is an active and ongoing program that was recently finalized and approved for implementation.

Methodology Components of the Sierra Framework Program

The basic methodology components of the program involve the use of GIS data and modeling to predict changes over time as a result of various prescriptions on National Forest lands. The program attempts to assess effects of these prescriptions on key resources through an effects analysis process. Key indicators are imbedded in all five components of the program and differ according to the questions that are addressed.

Data categories include desired feature conditions, vegetation composition, size classes of trees, canopy cover, watershed and stream location. The program relies heavily on the development and use of wildlife habitat relationships (WHR) models for selected species.

The optimum spatial scale for the program is generally an “ecoregion”, however it depends somewhat on what questions are being considered. The temporal scale that the methodology addresses is approximately 10 years.

Relatively little data screening is part of the program; and what is done occurs primarily as ad hoc quality control. There is no formal screening approach.

Subjective Evaluation of the Sierra Framework Program

The methodology is designed specifically for various habitat components of the Sierra Nevada. Limiting factors include the confidence in the underlying data, and the assumptions that underlay much of the modeling.

A Science Consistency Evaluation process provides a peer review component to the program. This involves assessing whether best available science was used in the process and whether uncertainty was adequately acknowledged. There is no field verification protocol for the program.

The methodology addresses human interaction with natural resources by making assumptions regarding uses such as timber harvest, fuel reduction, roads, etc.

This effort is best used for updating Forest Plans on the National Forests of the Sierra Nevada. A key strength of the program is that it attempts to address problems at an appropriate geographic scale rather than forest by forest. Weaknesses include its large geographic size and the scope of issues that it attempts to address. This expansive approach makes it difficult to apply and to be understood by the public. In addition, there has been constant tension within the program over the adequacy of data resolution.

Suggested modifications to improve this methodology include making a stronger investment up front in data development and to structure the analysis function in more of a "nested" manner in order to make it more easily understood and less cumbersome.

Broader Applications of the Sierra Framework Program

The philosophy and approach of the Sierra Framework has broader application than to just the Sierra Nevada. However, comprehensive approaches have significant challenges. The approach is cost and data intensive and the science, while at the core of the process, is always less than perfect and subject to intense scrutiny.

Program Overview of the US Forest Service Large-Scale Watershed Program

The US Forest Service Large Scale Watershed Program is aimed at improving watershed condition on both National Forest and non-National Forest lands in watersheds of approximately 200,000 acres or larger. The program is currently working in 15 major watersheds throughout the U.S. In California, the Upper Pit River Project is within this program.

A primary linkage between the Program and CCRISP is its interest in not just addressing natural resource needs, but human (community) needs as well. The Program will monitor not only the health and condition of watershed resources, but also of those who rely on those resources. As such, the Program provides a model that could have significant applicability to CCRISP.

Questions of the Large-Scale Watershed Program

A basic underlying question of the Large-Scale Watershed Program is what programs and projects need to be put into place to restore damaged environments and ensure the sustainability of both communities and resources?

Status of the Large Scale Watershed Program

This program is ongoing and is a primary new focus within the U.S. Forest Service with over $50 million in federal fund commitments.

Goals of the Large-Scale Watershed Program

Primary goals include the development of public/private partnerships to restore damaged environments and maintain the sustainability of communities and natural resources within the project boundaries.

Methodology Components of the Large-Scale Watershed Program

Basic methodology components include large-scale watershed assessments, prioritization of restoration activities, and development of a business plan in conjunction with planning and implementation partners, and implementation based monitoring and adaptive management.

Key indicators in the program include water quality, grazing standards, forest health indicators (primarily fuel hazard ratings), aquatics (sensitive aquatic resources), and riparian health.

The optimum spatial scale for this methodology is considered to be between 500,000 and 1,000,000 acres, although watersheds as small as 200,000 acres have been included. The temporal scale is based on a 5-year self-sufficiency goal after which the watershed becomes self-sustaining.

The program does not have a strong data-screening component. In about half of the current 15 projects, watershed data is tiered to other existing data sets.

Subjective Evaluation of the Large-Scale Watershed Program

This program is intended to be applicable to multiple types of regional landscapes, as evidenced by the fact that it is being implemented in 15 different watersheds from throughout the U.S.

A primary limiting factor of concern to the program is the NEPA compliance requirement to which the Forest Service must adhere, because NEPA compliance is so much more demanding than state environmental impact assessment laws. This can make forming partnerships difficult. Also, in some

rural watersheds, finding partners who can contribute funding has been a challenge. Another limitation is that data is not adequate for some watersheds and obtaining necessary date can be costly.

The program has no formal peer review process for the science component. However, the business plan is developed jointly by all participating partners. There is also the NEPA review process to evaluate the effectiveness and potential side effects on the environment. There are no formal field verification protocols, but all programs have monitoring components that may serve as a venue for field verification.

The methodology incorporates human interactions with natural resources in that community dynamics are a key part of the program. The program is not just aimed at protecting watersheds, but seeks to maintain the communities that occur within them as well.

This approach presents a new way of doing business for the Forest Service: a way that causes them to look outside of their forest boundaries at larger landscapes and have greater accountability to others. Because of this, the program has not been readily accepted by all within the agency. Its full potential has yet to be determined.

The strengths of the program include the fact that it provides for an integrated and collaborative approach to watershed planning and management. Weaknesses include the fact that personnel within the agency often do not want to relinquish control and therefore are not willing to participate fully, if at all. Also, scale issues in large watersheds can sometimes be overwhelming, as can the scope of required restoration.

A suggested modification for this program has been to allow it to be more locally driven, as opposed to receiving direction from the Washington office. Current plans call for this to happen beginning in 2002.

Broader Applications of the Large-Scale Watershed Program

By its nature, this program already has broad application. With additional funding and increased internal support from within the agency, the application could extend even further.

Program Overview of "Species and Natural Communities Assessment and Monitoring Program", Department of Fish and Game (DFG)

The Department of Fish and Game (DFG) is in the process of developing a new umbrella program that will incorporate the numerous ongoing efforts of existing programs into one integrated program. The program is being designed in-house, but has benefited from review of several other developing monitoring strategies

in state and federal government. Existing programs which focus on terrestrial species, freshwater/aquatic, habitat assessment/conservation will be incorporated into the new program. Programs which are already well established in monitoring, or are fairly well focused, such as Bay-Delta efforts, Marine Resources efforts, Cal-Fed efforts, or Native Anadromous fisheries efforts, will not be included.

The key indicators used by the program, assess the condition of resources or habitat. Therefore, it is likely that the methodologies of the "Species and Natural Communities Assessment and Monitoring Program" will be relevant to CCRISP.[10]

Basic Questions the Species and Natural Communities Assessment and Monitoring Program is trying to Answer

"The intent of the program is to enhance the understanding of the distribution and abundance of species and their habitat in California. The program will focus on species that are considered 'strategically' important to the overall mission for ecological, social, and/or economic reasons."

Goals of the Species and Natural Communities Assessment and Monitoring Program

The goal of the new program is to, "develop and implement a long-term and strategic program to assess and monitor the distribution and abundance of priority species (amphibians, fish, reptiles, birds, mammals, native plants), habitats, and natural communities in California." The methodology is intended to be applicable to multiple types of regional landscapes.

Status of the Species and Natural Communities Assessment and Monitoring Program

The Species and Natural Communities Assessment and Monitoring Program is currently in its formative stages. At the time of this writing, even the name of the program is in flux, and specific protocols are in development.

[10] The following information, highlighted by the text in quotations, was taken from a survey response by Eric Loft, Senior Biologist, Wildlife Programs Branch, Wildlife and Inland Fisheries Division, Department of Fish and Game.

Methodology Components of the Species and Natural Communities Assessment and Monitoring Program

The methodologies vary depending on the area of inquiry. DFG staff anticipates developing monitoring strategies for three components: terrestrial, aquatic, and habitat/community/landscape.

The key indicators for assessing resource or habitat condition have not been finalized, but DFG staff anticipate that distribution abundance, perceived risk/threat, disturbance factors, diversity and richness will be some of the variables for assessing condition.

The data categories for determining the condition of habitats or resources, will include categories such as presence/absence, trend, condition, population size, density, and dynamics, cause/effect relationships of human-caused disturbance (e.g., mining, grazing, fire suppression, biomass, timber harvest, recreation, etc.), and habitat relationships of individual species.

Data screening will be employed to insure data integrity and quality. Other mechanisms will ensure consistency in data formats. Data collection and analyses will follow scientific methods. Repeatability of results will be used as criteria for insuring integrity and quality of data.

There will be a field verification protocol for habitat mapping efforts. Species level data will be based on field sampling. Models to assess habitat capability and predictability will be validated with site visits. The specifics of field verification protocols are still in development.

DFG staff anticipates that input or peer review from other agencies will occur with program overlaps relating to assessments and monitoring. Most likely, this will involve distribution of draft monitoring protocols for review and comment.

The spatial scale of the methodology will vary from local planning to county to regional to statewide perspectives. The intent is to enhance the range-wide understanding of species, habitats and communities.

According to the respondent, the “Species and Natural Communities Assessment and Monitoring Program is intended to reflect long-term species & habitat change in intervals of five years or so.”

The methodology will incorporate human interaction with the resource (i.e., roads, land use, and activities or other interventions) as attributes to measure or be included in the assessments.

The program will contain provisions for adaptation and update. Mechanisms to: evaluate and review the program, modify it as needed, respond to feedback and address new priorities and/or management directions will be incorporated into the program.

The Respondent's Subjective Evaluation of the Species and Natural Communities Assessment and Monitoring Program

DFG staff is optimistic about this new program, and looking forward to implementing a systematic and consistent approach across administrative boundaries that focuses on developing the best data that can be produced for species/habitats, which are anticipated to be priorities.

According to the respondent, the anticipated strengths of this methodology are consistency, systematic methods of approach with feedback mechanisms and ongoing review to ensure focus on priority issues.

The new "Species and Natural Communities Assessment and Monitoring Program" is still in development, but the primary weakness will be "trying to take on too much." The respondent admitted that "this is an overwhelming task, overwhelming tasks don't get done. We need to make sure we stay within the practical limits of funding/personnel and remind ourselves as a department what our job is, so that we can focus".

Broader Applications of the Species and Natural Communities Assessment and Monitoring Program

The intended end users of the program, or information generated by the program, will be stakeholders and decision makers — including the Department itself, other agencies, land use planners and the public.

It is anticipated that some of the data will be proprietary in terms of providing it to the public. DFG staff anticipates some "generalizations" of the data (such as general locations of nest sites) would be needed for certain species (or similar for certain plant species/communities).
The respondent was optimistic that many of the methods they are developing for species and habitats would be applicable to other State assessment programs.

In addition to the new "Species and Natural Communities Assessment and Monitoring Program", the DFG is working on reviewing and developing its resource/land acquisition strategy using some of the same kinds of concepts for developing priorities. Land acquisition planning will be a beneficiary of the more comprehensive assessment and monitoring program that will be developed by the DFG.

V. Appendices

Appendix A: Glossary

Appendix B: Survey Questionnaire

Appendix C: Bibliography

Appendix D: Attachments

Appendix A: GLOSSARY

Biodiversity: A term derived from "biological diversity" that includes three levels of biological variability - ecosystem complexity, species richness, and genetic variation. In this document, the prime concern is at the level of species.

Community: A general term applied to a grouping of plants or animals that form part of an ecosystem and give it a certain degree of individuality, e.g. plant community, or animal community of a prairie ecosystem. In this document, *community* refers to plant community unless otherwise qualified.

Cover: The area occupied by individuals of a species. It is usually determined by measuring the area of the ground covered by a plant, either by vertical projection of the area covered by the leaves of a species or by measuring canopy width. It is used to determine dominance.

Density: Describes the number of individuals of a species on a unit area basis.

$$\mathbf{D} = \frac{\text{number of individuals of a species in the sample}}{\text{total area in the sample } (m^2)}$$

Dominance: Area occupied by a species on a unit area. Use basal area or cover as the measurement for area occupied.

$$\mathbf{Dom} = \frac{\text{basal area or cover of a species in the sample } (m^2)}{\text{total area of the sample } (m^2)}$$

EMAN: Ecological Monitoring and Assessment Network. EMAN comprises a network of approximately 100 research and monitoring sites in Canada which are organized in 14 terrestrial Ecological Science Cooperatives. EMAN provides a national perspective on the impacts of environmental changes on ecosystems, an early warning system that identifies new ecosystem changes as they emerge and reports on their distribution.

Ecotone: A typically narrow, usually sharply defined zone of vegetation (transition zone) that separates two different plant communities, e.g. in riparian or lacustrine zones but sometimes quite broad as between two different biomes e.g. the prairie parklands between the prairies and the boreal forest.

Ecosystem: A dynamic complex of organisms (biota) including humans, and their physical environment interacting as a unit. They may vary in size and composition, the term being applied to the whole world and its atmosphere, to

units dominated by particular plant types (prairies, boreal forest) to a local pond, or quarry. In its broadest sense it includes environmental, biological social and economic elements.

Ecozone: The largest ecological unit in the ecological land classification for Canada. Ecozones are subdivided into progressively smaller units based on similarities or dissimilarities in ecological characteristics, such as climate, soil or water properties, and the biota. Each ecozone is subdivided into ecoprovinces, each ecoprovince into ecoregions, and each ecoregion into ecozones.

Flora: All the plant species that grow spontaneously in a particular area/region or period, listed by species and considered as a whole; presence, not numbers of individuals, is what counts.

Field Layer: See stratum.

GIS: Geographic Information Systems, a data and information system developed for a wide variety of applications generally for the purpose of quantifying and analyzing physical areas and the specific attributes present within those areas

Ground layer: See stratum.

Ground vegetation: As used in this document, a combination of the field and ground layers (see stratum); includes all herbaceous species in a community and all woody species up to 1 m in height, and non-vascular species such as mosses, lichens and mushrooms; includes small shrubs and tree seedlings.

GPS: Global Positioning System. GPS is a satellite navigation system which provides specially coded satellite signals that can be processed in a GPS receiver to compute the location of the instrument. Four GPS satellite signals are used to compute positions in three dimensions.

Lacustrine: Pertaining to lakes; also refers to the characteristic zones of vegetation fringing a lake.

Meta data: Information about what is in a data set; often defined as "data about data".

Nested plots: A sampling system in which plots of different sizes are so arranged that larger plots contain the smaller ones.

Non-forest ecosystem: Grasslands, shrublands, chaparral, wetlands, deserts, etc., where trees are not the dominant life form, although they may be present as scattered individuals or in patches. See forest ecosystem.

Plot: A general term referring to any area of land of any shape (e.g. circle, square, rectangle etc.) or size, which may be used for any purpose (e.g. sampling).

Phenology: The science dealing with the influence of climate (e.g. seasonal changes) on the recurrence of such annual phenomena as leafing out, flowering, ice cover or break-up, etc.

Quadrat: A specific ecological sampling term that refers usually to a square (original definition) or rectangular sampling plot of a predetermined area/size.

Relative Density: Describes the density of one species in relation to the density of all species.

$$\textbf{RD} = \frac{\text{number of individuals of a species in the sample}}{\text{total number of individuals of all species in the sample}} \times 100$$

Relative Dominance: Describes the area occupied by one species relative to the area occupied by all species in the sample area. Basal area or cover are the variables commonly used for determining this value.

$$\textbf{RDom} = \frac{\text{basal area or cover of species in the sample } (m^2)}{\text{total basal area or cover of all species in the sample } (m^2)} \times 100$$

Relative Frequency: Describes the distribution of one species relative to all species in the sample.

$$\textbf{RF} = \frac{\text{frequency of a species}}{\text{total frequency of all species in the sample}} \times 100$$

Responsible Group: Refers to the decision-making team with overall responsibility for determining and managing all the research and monitoring at the site under consideration.

Riparian: Pertaining to rivers, wetlands, water bodies, it refers to the characteristic zones of vegetation fringing water bodies whether bordering a river or a lake; forests fringing rivers in grassland areas are sometimes known as gallery forests.

Sample: Example or portion showing qualities and characteristics of a whole. The number of quadrats used for sampling a particular stand; the area enclosed by a quadrat.

Savannah: Grass-dominated ecosystem with scattered trees or tall shrubs or small clumps dotting the landscape; often transitional between forest and true grassland.

Stand: Standing growth of plants; a particular example of a plant community, e.g. forest or grassland in which monitoring plot(s) are established.

Stratification: The grouping into height classes of individual plants in a community or habitat.

Stratum (pl. strata): A horizontal layer of vegetation; most plant communities form well developed strata which are occupied by groups of species characteristic of that stratum.

Field layer: Made up of herbaceous species of any height, and woody species up to 1 m in height. In this document combined with the ground layer and called ground vegetation.

Ground layer: Vegetation on the surface of the ground; usually mosses, lichens, and fungi together with low-growing herbaceous species, especially those with trailing or rosette growth forms. In this document combined with the field layer and called ground vegetation.

Survey: As used in this document, the formal process for laying out a plot using survey methods.

Systematics:the study of taxonomy and phylogenetic relationships of organisms.

Taxon (pl: taxa): Any unit of any rank within a taxonomic classification, e.g. genus, species, family, etc.

Taxonomy: The science of classifying and naming organisms.

Transect: A line or belt of vegetation selected for sampling; as used in this document, a continuous string of contiguous quadrats set in a line across vegetation gradients.

Vegetation gradient: Obvious changes in the type of vegetation across a landscape as a result of some physical change e.g. change in moisture regime: as the distance from a water body increases, the vegetation may change from herbaceous species, through shrubs and trees to a grassland; or change in elevation: as altitude increases, the vegetation may change from tall trees to small trees to alpine tundra (see also ecotone).

Voucher specimen: A properly mounted/preserved and archived specimen that serves to "document" the use of a specific name, or the presence of an organism in a particular place.

Appendix B: Survey Questionnaire

We are conducting a review of the status of resource-related assessment methodologies that are being developed or in use within California state agency programs. The programs of interest are ones that involve assessing the health or condition of biological resources, habitat areas or working landscape resources. This investigative project is intended to produce a preliminary overview of current resource assessment methodologies in order to gain a better insight for determining an optimum methodology for assessing the condition and health of priority conservation lands.

The Office of Environmental Health Assessment EPIC Program has been identified as a relevant program that is already underway in developing methodologies for resource assessment. Our scope for investigation is narrowly confined to how you look at available information and what type of decision-making process you will employ to make a determination regarding the condition of the resource.

This is not an assessment of the information or data used by your program. Nor are we attempting to make the determination regarding the relative importance of specific resource features, units or areas within the purview of this program. Rather our objective for this investigation is to identify and compare the range of methodologies currently being employed by state programs involved with resource and habitat assessment and monitoring.

Questions

1. What are the **basic questions** that the program is trying to answer?_____

2. What are the program's **primary goals**?_____

3. Please describe the basic **methodology components** that are employed in your program?_____

4. What **key indicators** are used, if any, for assessing resource or habitat condition?

5. What **data categories** are required for determining habitat/resource condition?

6. What is the **spatial scale** that this methodology is intended for?_____

7. What **temporal scale** does this methodology address?_____

8. What type of **data screening** is employed?_____

9. Data screening based on what criteria?_____

10. Is the methodology intended to be applicable to **multiple types of regional landscapes** or is it catered to a specific landscape type?

11. Is there a **peer review component** to this assessment methodology?

12. What does the peer review involve?

13. Is there a **field verification** protocol? If so what does it involve?

14. How does the methodology incorporate **human interaction** with the resource i.e., roads, land use, and activities or other interventions?

15. What are your thoughts regarding the **usability** of this approach?

16. What are the **strengths** of this methodology?

17. What are the **weaknesses** of this methodology?

18. What **modifications** would you suggest to improve this approach?

19. In your opinion is this methodology **applicable to other State assessment programs**?

If so how?

And if not why?

20. Are there provisions for **updating** the program?

21. Other **Adaptive management** features?

22. Who are the intended **end users**?

23. Is any of the **information proprietary** in nature and if so how is the proprietary issue handled?

24. Was the program designed **"in-house**" or through a **stakeholder** process?

25. Intended for **broader stakeholder use**?

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Appendix D: Attachments

Attachment 1:
Draft EMDS Core Reserve Model:
Netweaver Fuzzy-logic Knowledge Base

Attachment 2:
Flow Chart,
North Coast Watershed Assessment Program

Attachment 3:
North Coast Watershed Assessment Program,
Stream Conditions for Fish Production

Attachment 4:
Conservation Design Database Structure (CAD)

Attachment 5:
FRAP Monitoring/Assessment Bibliography

Attachment 1:

Draft EMDS Core Reserve Model:

Netweaver Fuzzy-logic Knowledge Base

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Flow Chart,
North Coast Watershed Assessment Program

Attachment 3

North Coast Watershed Assessment Program, Stream Conditions for Fish Production

Attachment 4:

Conservation Design Database Structure (CAD)

Attachment 5

FRAP Monitoring/Assessment Bibliography

3.51 FRAP Monitoring/Assessment Bibliography

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